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PAVING
AND
Municipal Engineering

A Journal Devoted Specially to Street and Sidewalk Paving, Water Works Construction, Bridge Building, Street Lighting, Sewerage and all Matters Pertaining to Public Improvement in Cities.

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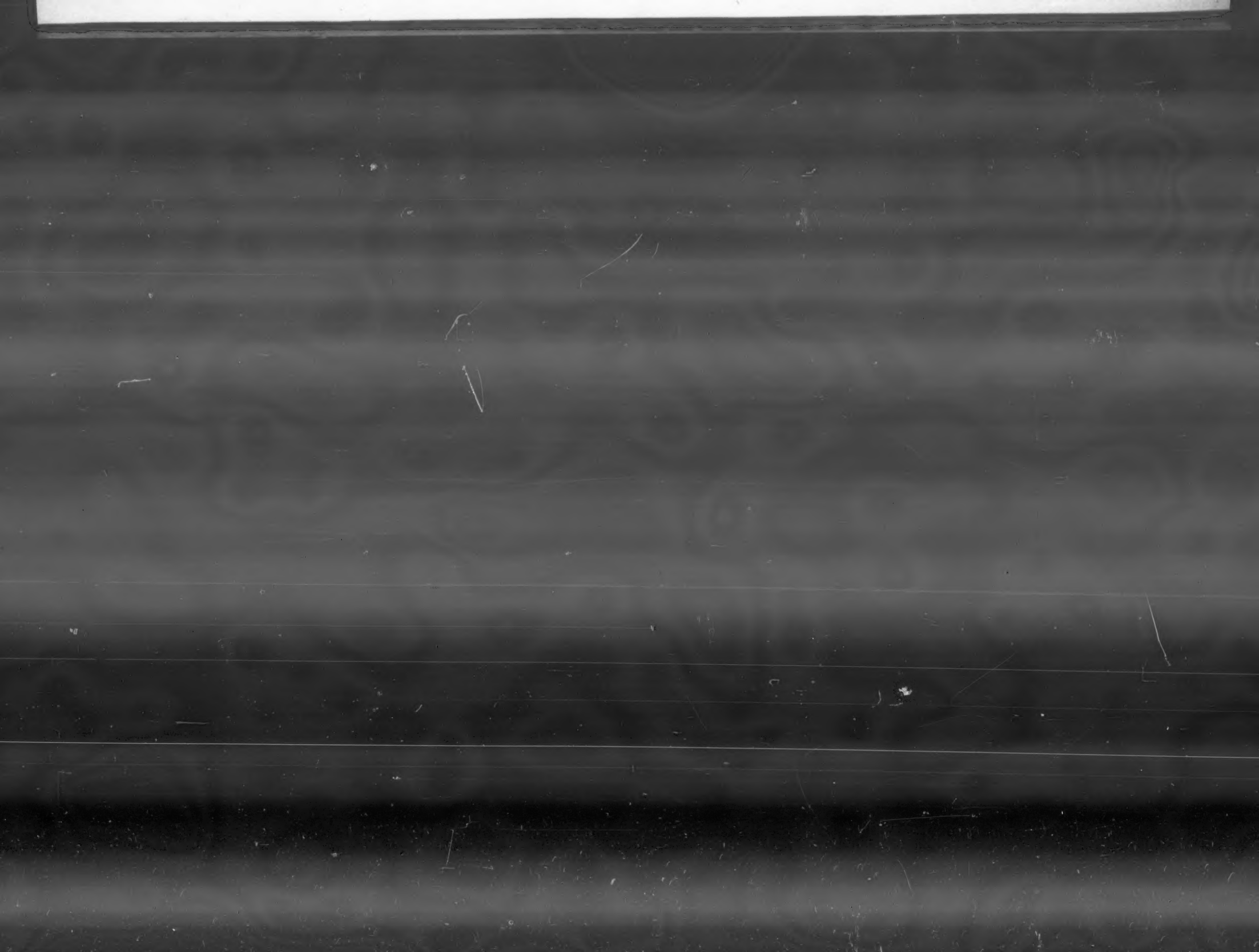

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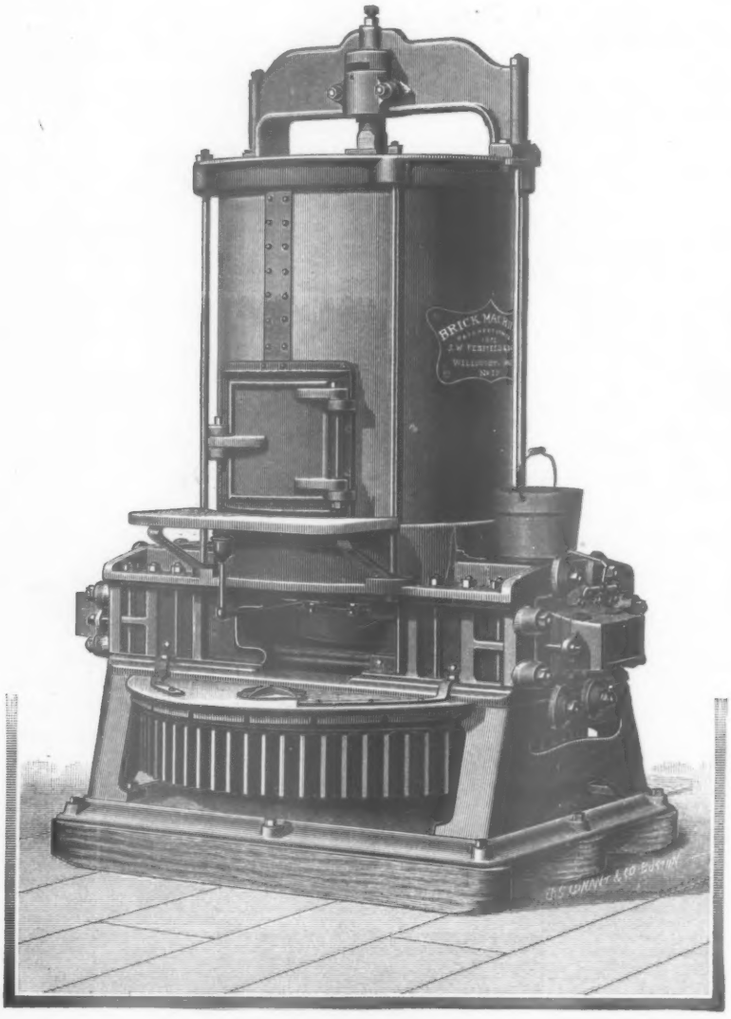

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PAVING
AND
Municipal Engineering

VOL. 1. INDIANAPOLIS, IND., JUNE, 1890. No. 1.

Paving and Municipal Engineering

A Journal Devoted Specially to Street and Sidewalk Paving, Sewerage, Water-Works Construction, Street Lighting, and all Matters Pertaining to Municipal Engineering.

Published on the 15th of Each Month.

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Advertisements to insure publication should reach the publication office not later than the 5th of the month.

Communications are invited, and all requests for special information on the subjects treated by this journal will receive careful attention.

Articles relating to the different branches of municipal engineering are desired. Stamps should accompany manuscripts for return postage if unavailable.

FEATURES OF THE NEXT NUMBER.

Among the specially interesting features of the next number of PAVING AND MUNICIPAL ENGINEERING will be articles on "Brick Paving" and "Pavement Construction and Economics."

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BEGINNING.

WHEN the idea of holding a street-paving exhibition in Indianapolis was conceived, and the project fully determined upon, difficulty was at once encountered in opening communication with paving companies that were desired to make exhibits, and it was only after persistent inquiry among persons engaged in the business that the addresses of about thirty firms were obtained. These were at the time supposed to be all that there were in the country, and, anyhow, all that the managers could get trace of through such advertisements as could be found, or such information as competitors in the paving business would or could give. It was supposed when the project was undertaken that there was some publication in the country that afforded a medium of communication with all engaged in the paving business, but it was soon found that while there were several journals which incidentally, or in a minor way, gave some attention to street improvement, there was no publication devoted specially to such interests, and that comparatively little information could be gathered from either the advertising or editorial departments of those that gave any kind of attention to the business. It was, therefore, concluded that the business was confined to a few firms, and that the proposed Exposition would necessarily be of small proportions. It was, in consequence, arranged that it should be held in Board of Trade hall. In pursuance of the determination to make the most of the Exposition, it was generally advertised, however, with the result that this indirect method brought information of many companies that could not be directly reached, and when the Exposition opened there were fifty-five exhibitors instead of but thirty, and it was necessary to hold the exhibition in the largest hall in the city, in which 360 feet in length of space was occupied. The Exposition was to everybody a surprising revelation of the magnitude of the paving business. The need of its being better advertised, which had made so much trouble for the managers of the Exposition in their efforts to get information regarding paving companies, had been most strikingly demonstrated.

In consequence of the city having been brought into prominence as a center for information on the subject of street improvement, many letters have been daily coming to Indianapolis since the close of the Exposition, making inquiries regarding paving and asking for addresses of those engaged in the business. The increasing number of these inquiries and the manifest widespread interest in street improvement, suggested the starting of a publication devoted specially to such matters. After several days of deliberation, a prospectus for such an enterprise was prepared and was issued about a month ago. The name which had at that time been chosen for the publication was PAVING AND SEWERAGE. The responses to the prospectus were highly encouraging, and the publishers were strongly urged to broaden the scope of the journal, so as to embrace the whole field of municipal engineering. After careful consideration the suggestion was adopted, and with the idea of continuing to make paving a specially prominent feature it was decided to change the name to PAVING AND MUNICIPAL ENGINEERING. All branches of municipal engineering will be given attention, and in future numbers the operation of water-works, the construction of sewers, the building of bridges and the lighting of streets are interests that will be made more prominent than, after the change of plans here explained, could be done in the present issue. In broadening the scope of the publication it is our determination to make it not only a medium of information fully meeting all needs, but to also give it such character that it will be recognized as authority on the subjects it will treat without making it technical. It is our desire to make the publication of some influence in stimulating a spirit of public improvement, and with that purpose in view we shall endeavor to give information of a kind that will tend to awaken a greater popular interest in public improvement rather than to make the journal technically instructive in municipal engineering; but when technical opinions are given they will be such as will have the approval of experts.

THE ACCURSED COBBLE-STONE.

SMOOTHNESS or even surface is one of the most essential qualities of a pavement. It is equally as important as durability. The merely durable may be as undesirable as no pavement at all. The cobble-stone painfully illustrates the truth of this remark. It marks an era of progress in road improvement but one step beyond barbarism. There is no harmony between civilization and cobble-stones. In

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this day they represent, in comparison with modern paving, a kind of brutal ignorance—born of penny wisdom and pound foolishness—of requirements in street improving. It is in its way durable enough—it is far too durable for public good. By many its durability is believed to give it the usually first considered, but really doubtful, merit of cheapness. In actual first cost it is cheap, but its ultimate cost is the greatest of any pavement in use. The wear and tear that it involves in travel to man, beast and vehicle is incalculable, but it is known to be a fact that a vehicle in use on cobble-paved streets requires repairs, during any period of five years, costing five times as much as the needed repairs of one used on wood block or other pavement of more even surface. A horse ordinarily travels three times as fast on the smoother pavement as on cobble-stones, and if driven on an average four hours daily, remains in good condition four times as long. It requires ninety pounds of force to draw a ton upon cobble-stones, thirty-three pounds on the best granite blocks, and but fifteen pounds on the pavement of even surface. A few years ago it was estimated that in New York twelve thousand trucks were carrying an average load of one and one-half tons twelve miles on each of three hundred days in the year at an average daily cost of four dollars for each truck. In this calculation is involved the transportation of sixty-five million tons one mile a year at a cost of $14,400,000, the rate being twenty-two cents per ton per mile. The same transportation by rail now costs six-tenths of one cent per mile. On a smooth pavement a load three times as heavy as the loads on the rough pavements could be drawn by horses. The saving in transportation would, therefore, amount to nearly $10,000,000 per annum, which would pay for many miles of good paving. In any city where cobble-stones are in such general use that travel must necessarily be over them, the aggregate loss from wear and tear is annually enough to pay a large per cent.—more or less, according to population—of the cost of new paving of the traveled streets.

Experience has fully demonstrated that even surface is equally as important as durability. The latter must be taken into account, but is not to be considered alone. The measure of its importance has been aptly illustrated by a comparison with leather breeches. The durability of leather is infinitely greater than that of cloth, but no man in a civilized community prefers breeches of leather to trowsers of cloth, simply because they will not wear out.

THE WARING SYSTEM OF SEWERAGE.

THE success of the Waring system of sewerage, in Memphis, since its introduction there following the yellow fever epidemic eleven years ago, has led to its adoption in a great number of the smaller cities of the United States, and it has been introduced as an experiment in Paris. Among the cities that have brought it into use since it has proven satisfactory to the Memphis people, are Kenna, N. H.; Chelsea, Lenox and Pittsfield, Mass.; Stanford, Conn.; Round Lake, Schenectady and Corning, N. Y.; Mt. Holly, East Orange, Long Branch and Englewood, N. J.; New Castle and Wilkesbarre, Pa.; Norfolk, Va.; Pensacola, Fla.; Birmingham and Decatur, Ala.; East Liverpool, Kalamazoo, Mich.; Lincoln and Omaha, Neb.; Wichita, Kan.; Pueblo, Col.; Ft. Worth and Little Rock, Ark.; Pullman, Ill.; Santa Barbara, San Diego, Coronada Beach, Alamedo, San Bernardino and Riverside, Cal.; El Paso, Texas; and Leavenworth, Kansas. Plans have been prepared and in most places executed for the following additional places: Laconia, N. H.; Athol and Wesboro, Mass.; Hoosaic, N. J.; Charleston, S. C.; Savannah, Ga.; Nashville, Tenn.; Owensboro, Ky.; Wyoming, O.; Danville, Ill.; Springfield, Mo.; Kingston, Ia.; Emporia, Kan.; Sacramento and Stockton, Cal.; Seattle, Wash., and Kingston, Island of Jamaica.

The distinctive features of the system are:

1. The small pipes used. In Memphis the largest sewer (brick) is only twenty inches in diameter. The pipes from the houses to the street connections are uniformly four (4) inches and are the glazed sewer tiling with cemented joints. The next sizes are 6, 8, 10, 12 and 15 inches.

2. At the end of each extension there is a flushing tank with a capacity of 120 gallons of water, which empties itself automatically at stated intervals.

3. All surface water, street washings, and even the roof and house-yard water is excluded from the drains.

4. All sewage, liquid or solid, kitchen and laundry slops, and factory liquid refuse is admitted.

5. There are no man-holes, nor catch basins, and the pipes are ventilated by shafts in connection with each house.

6. The sewage and all liquids entering the pipes, owing to the small size of the pipes, is carried along so rapidly, especially by the copious and systematic flushings, that the pipes are kept perfectly clean, and no decomposition or fermentation of the sewage takes place before it finds its way into its place of disposal.

7. The cost of construction and maintenance is about one-tenth of the old combined system, where storm water and all surface water must be provided for in some sewer.

Its growing popularity is in a measure due to its comparative cheapness, which is a distinctive merit, because it enables places to have the benefits of sewerage that would otherwise not have them. It has been recently very strongly endorsed by Dr. J. F. Kennedy, secretary of the State Board of Health, of Iowa, for use in some of the cities of that state. His approval of it, from a sanitary point of view, is based largely on his knowledge of its use in Memphis, which has been transformed from one of the most unhealthy cities in the United States, to one that "has now a mortality that will compare favorably with the best in all the land."

In giving his observations, Dr. Kennedy, in an official communication, says: "When the American Public Health Association was held in Memphis three or four years ago, there was nothing in connection with the city that elicited so much interest and called out so much hearty commendation as their wonderful system of sewerage."

The Memphis *Commercial* in a recent article congratulates the people of that city upon the sanitary condition of the place and boasts of its healthfulness, which is attributed to the sewerage system in use.

WHERE ASPHALT IS OBTAINED.

ASPHALT is obtained in many parts of the world. It is found in the Neuchattel District, in the Valde Travers, in Venezuela, in Cuba, in Utah, in the Santa Cruz District, California, and on the Island of Trinidad. So far it has been found naturally compounded with the various earthly elements through which it must have passed in coming to the surface. The European rock asphalts are an admixture of the asphaltic pitch with a chalk stone or finely powdered limestone. Deposits of the bituminous sand rock, which is being introduced in street paving in competition with asphalt, to which it bears a close resemblance, are found in Grayson county, Kentucky. The Cuban and Venezuelan asphalts are distinctively an asphaltic pitch. The Trinidad asphalt is found in combination with coke and ash, which are substantially eliminated by boiling at a high temperature, when by precipitation this material settles, and the asphalt pitch is poured off. This latter is the Trinidad asphalt of commerce, and in the mixture made under the recognized formulas, combined with sand and stone-dust, and is the wearing surface of the successful pavements laid in the various cities in this country. The California asphalts are a natural admixture of asphaltic pitch and sand, and the asphalt is found in the sand in the ratio of from 8 per cent. to 12 per cent. This material has been with success laid upon the streets of Los Angeles, Santa Barbara, San Diego and San Francisco. Twenty years of experience has demonstrated that is a safe business risk to build a Trinidad asphalt street and to guarantee it for five or ten years.

Asphalt is not a modern discovery. It was well known in Egypt in the days of the Pharaos, and the excellent condition of the mumified dead of that old world is due in a large degree to the use of asphalt in and about the cerements which enclosed them. The material in itself is indestructible, except by fire. Acids will not destroy it, and at places on the Island of Trinidad, where ledges of asphalt have been for a long period exposed to the action of the sea, there has been no perceptible disintegration, either from the wash of the ocean or from the chemical action of the air or water. In fact, latter day engineers have been instructed by the accidental discoveries of the excellencies of this material, as found in old foundations and pavements in and about Egypt and in Rome, some of which were constructed more than 2,300 years ago.

COST OF PAVING.

A FEW months ago a committee of one hundred, composed of leading citizens, was organized in Dayton, to undertake the improvement of the streets of that city, and as a first step the secretary of the organization, Mr. Benj. Marot, was instructed to gather such information as he could obtain on the subject of street paving. He opened correspondence with a number of municipal officers in the United States and Europe, the results of which have been embodied in a pamphlet, which has recently been published for the information of the

people of Dayton, interested in the subject. Mr Marot's summary of his correspondence, as to the cost of pavements, about which inquiry is most commonly made, is as follows:

"The cost of stone block pavements varies so greatly that I have been led to investigate closely the reasons, and I find them to be partly in the difference in the dressing of the blocks, a first-class pavement requiring a first-class dressing; largely in the character of the foundation; somewhat in the price of labor, and considerably in the difference in freight on the material used. The best Medina stone block pavements used in Buffalo, Cleveland and Rochester, cost, including grading and curbing and all work, $3 to $3.15 per square yard. At Philadelphia the cost is $3 for their best granite pavement, while at Cincinnati it is $4.25 for granite, and $3.75 at Columbus for Medina stone. In the New England States the cost is from $2.10 at Springfield for granite on sand foundation, to $3 at Boston for the same material on stone foundation, with one piece at Providence on concrete foundation costing $4. Almost all New England and interior New York cities use only a sand or gravel foundation, at a cost of from $2.10 to $2.50 per square yard, as do also Milwaukee and Minneapolis, this cost being for the complete street. Asphalt costs from $2.75 to $3.50 for the complete street, the latter price being for Barber asphalt laid on a concrete foundation. Congress prescribes in its appropration bill, that asphalt pavements in Washington shall not cost more than $2 per square yard, which, I infer, does not include curbing, grading and excavations.

"Brick pavements cost from $1.65, laid on sand or gravel, to $2.50, laid on concrete, the cost further varying under the same influences that affect the cost of other pavements.

"All New England cities heard from, with one exception, place the entire cost of all street paving on the general tax duplicate—that is, the city at large pays the entire cost. With few exceptions, New York, Pennsylvania, and western and southern cities, assess the entire cost, except intersections, on the abutting property in proportion to frontage. In Cincinnati the city pays one-half the cost, as does also Philadelphia. At Utica, New York, the city pays one-half, while Chicago assesses the cost on the abutting property according to the benefit derived. Other cities vary slightly in practice, but fully two-thirds of the American cities heard from, put the whole cost of street paving, except street and alley intersection, upon the abutting property. In England and Ireland, all new streets are made at the cost of the abutting property, while all other streets are paved and otherwise improved at the expense of the city."

He very wisely reaches the conclusion in his report that money should not be wasted in making experiments, but that cities should "take only that which is known to be good and durable," and further he says: "It will be poor economy to adopt any but the best pavements, not the most expensive perhaps, for no doubt there is a limit in cost, to go beyond which would bring no practical benefit, but the best, every essential point being considered, is the cheapest. If a cheap pavement is adopted, the cost to maintain it will be so excessive as to more than make the difference between its first cost and that of a first-class pavement."

Information recently gathered from many of the leading cities, in behalf of the Commercial Club, of Indianapolis, shows that the average cost of the various kinds of pavements in different places is as follows:

Cities.	Stone.	Asphalt.	Brick.	Wood.
Baltimore	$2.35 to 3			
Boston	2.75	$3.50		
Buffalo	2.75	3.00		
Cincinnati	4.25	2.85	$2.25	$3.50
Columbus, O	2.80 to 3.50		1.58 to 2.16	
Chicago	3.52			
Kansas City	3.40	2.80	2.00	1.50
Louisville		3.00		
Lowell, Mass	2.00 to 2.25			
Memphis	4.25 to 4.35		2.68	
Newark, N. J	1.75 to 2.80	2.85		
New Haven, Conn	2.50	2.75		
Omaha	2.20	2.95	2.03	1.36½ to 1.62
Paterson, N. J	1.50 to 2.30			
Philadelphia	2.50			
Providence	2.75 to 4.50			
Richmond, Va	2.45 to 2.48			
Scranton, Pa		2.65		
St. Joseph, Mo	4.40	2.80	1.75	1.53
Troy, N. Y	2.45 to 2.90			
Wilmington, Del	2.25			
Wheeling, W. Va			1.30	

The variation in prices is due largely to differences in foundations, the distances of points of supply of material from the places where the work is done, and differences in work.

THE INDIANAPOLIS PAVING EXPOSITION.

INDIANAPOLIS is one of the rapidly growing American cities that is just now entering upon an an era of general municipal improvement, and it is probable that within as short time as the work can be properly done, over 100 miles of streets will be newly paved. As the first step toward getting satisfactory work, it was decided to hold a Street Paving Exposition, at which would be exhibited specimens of material and work, thus enabling the people to determine, after obtaining a thorough understanding of the merits of the various methods of paving, how the streets of the city should be improved. The idea was conceived by the Commercial Club, the organization which undertook the management of the Exposition. The date fixed for the opening was less than one month from the time the project was first thought of, and it was, therefore, necessary to use the telegraph wires pretty freely in arranging with paving companies to send exhibits. It very quickly grew beyond all expectation, and was, by good management, made a remarkably succesful affair.

During the five days that the Exposition continued it was attended by over twelve thousand people, and was visited by over five hundred officials representing cities in several states, among the number being Hartford, Conn., Lexington, Ky., Anderson, Benton Harbor, Mich., South Bend, Waterbury, Conn., Rochester, Detroit, Mich., LaPorte, Omaha, Neb., Frankfort, Lebanon, Bridgeport, Ohio, Evansville, Mt. Vernon, Peoria, Ill., Danville, Ill., Goshen, Layfayette, Grand Rapids, Mich., Kokomo, Jamestown, New Albany, Montezuma, Marion, Attica, Franklin, Tipton, Logansport, Keokuk, Iowa, Muncie, Bay City, Mich., Dayton, Ohio, Richmond, Newport, Ky., Shelbyville, Terre Haute, Springfield, Ill., East St. Louis, Ill.

The exhibits numbered fifty-five, and occupied 360 feet of space in length. The Exposition was such a notable success that the managers determined to continue it permanently and to enlarge and improve it from time to time.

The official report of the Exposition has just been printed, and is now being circulated. It makes a pamphlet of fifty-six pages, and gives a full account of the work that was done in making arrangements for the Exposition, a brief description of each of the exhibits, a few suggestions regarding paving, and, finally, official reports that were made by delegations of municipal officers from other cities that visited the Exposition. The committee refrains from recommending any particular pavement, for the reason that they believe it not their province to pass judgment upon the merits of exhibits, but rather to furnish information regarding them. The report says: "The various kinds of paving have peculiar merits or are especially adapted to streets which have particular needs. Those who understand those needs can best judge which kind of paving is suited to the requirements of a street, and the information here given we believe to be a better guide to a safe and correct conclusion than would be any recommendations that we might make."

Under the head of suggestions, the report says: "The information we have gathered leads us to the conclusion that the matter of first and greatest importance in street paving is the foundation, which we believe should be of concrete, fully six inches in thickness. We believe that the various methods of paving—stone, asphalt, brick, wood and macadam—have special merits for particular streets on which the traffic is suited to their uses, but that on the leading business and residence streets the pavements that will probably be found the most satisfactory, in view of experience in other cities, are asphalt and brick of the most durable qualities, and that where put down, a guarantee for not less than ten years should be required. For heavy traffic stone is unquestionably superior to all other kinds of material. We believe that a uniform system should be adopted for the improvement of the streets of Indianapolis. In carrying out such a system, we believe that an effort should be made to have sewer, gas and water-pipes laid, and necessary connections made to the curb line, before concrete foundations are put down on the streets. We believe that a uniform style and quality of curbing should be used, and that there should be a uniform method of setting and trimming shade trees along the streets."

BRICK paving is becoming especially popular in western cities which have within convenient distance the quality of clay that is required for the manufacture of blocks sufficiently hard for street wear. Burlington, Iowa, some time ago put down three or four miles of brick pavement. The experiment has proved satisfactory, and steps are now being taken to put down brick on all the streets of the city.

A CORRESPONDENT of the Sioux City (Iowa) *Journal*, in giving an account of the beginning of the paving brick industry in Galesburg, Ill., says: "In 1883 there was a brick-yard on a vast stratum of fine clay, about two miles east of town. That year an order was given for some brick to be burned extra hard for laying sewers. The result was a brick of extraordinary fineness of texture and toughness. That was the foundation of what has grown to be a great industry in the manufacture of paving brick. Some one wondered if this remarkable firm brick would not do for paving. Paving was a serious problem here, for Galesburg was a prairie city, built upon such mire as only the soil of Illinois can make. Others remembered the experience of Bloomington, Illinois. Finally Prof. Churchill, of Knox college, and also city engineer, who had traveled extensively in Europe, took kindly to the idea. The next year, 1884, the main street for four blocks was paved experimentally. The test was a success beyond all anticipation. From that day to this paving with brick has been carried forward until now there is between four and five miles of it. Go to-day and take up one of the brick laid six years ago, on which there has been the severest strain of travel, clean it up, and you can not find a sign of a scratch, and it is not easy to tell it from a brick fresh from the kiln. There has not been a single brick replaced nor a dollar expended for repairs. Everything indicates that fifty years hence these same brick will be in substantially as good condition as they are to-day. This city would not allow you to lay wooden pavement if you would do it free of charge." The Galesburg method of paving, which, however, may be improved upon in some respects, is described as follows: "Grade down the street to the desired lines, and then the best but not essential way is to lay four or five inches of macadam. Then put on four inches of sand, wet down thoroughly and level it. Then there is one course of brick flat on the sand and lengthwise of the street, which should be rolled with a light roller. Upon the first course of brick is put one inch of sand, and then there is the final course of brick laid on edge and crosswise of the street, upon which there is put one-half inch of sand to fill the crevices, and the whole should be rolled to make an even and perfectly smooth surface. The street is graded in oval form, with a fall of six inches in nineteen feet from the center. This fall continues to within about three feet of the curb, the street for the latter distance being level to within one foot of the curb, where there is a rise of one inch."

UNTIL the people of America acquire a better knowledge of road-making there can be no marked or general improvement in the highways of the country. A practical and commendable move, which gives promise of resulting in great benefit, has been recently started in Ohio by a Cleveland educational institution, which proposes to give instruction in simple methods of road-making. Road supervisors have been specially urged to avail themselves of the opportunity presented to them to learn how their duties should be performed. Work of the same kind was undertaken some time ago at Vanderbilt University, where one highway official from each county in the state is given without charge a course of instruction in road engineering. The idea is one that may be made of incalculable benefit. State legislatures could well afford to appropriate $25,000, or even $50,000, a year for institutes similar to those of the farmers in some states, to be held in each county for several days every year, at which instruction in road-making could be given to supervisors and others, thus preparing them for the proper performance of work that fully three-fourths of such officials at present know little or nothing about. The roads of Europe are better than those of America, because they are under the care of men who have practical knowledge of road-making and receive constant attention. The improvement that would be certain to result from this method of training in their duties the men who have charge of the roads would be of almost incalculable benefit, but certainly it would be worth many times the cost to the public of the instruction.

A NEW paving material called "Rockboard" has been patented by John F. Gesner, of New York. It is mottled in appearance, with a smooth, hard surface, and for street paving is made in slabs six by three feet in size, and from three to six inches in thickness. The blocks are tongued and grooved and laid with joints broken diagonally across the street. It is intended that it should be laid on a solid foundation, and it is claimed for it that blocks can be removed at any time without the changes affecting the condition of the pavement. It is intended for use, also, for sidewalks and floors.

MOVEMENTS to secure the improvement of streets have recently been inaugurated in many cities, and a progressive spirit giving evidence of appreciation of the importance of good roads is very generally shown. A notable manifestation of it is given in the seeking of information on the subject of paving. Many of the civil engineers in the leading cities in the United States are daily receiving letters of inquiry from persons who, as the representatives of municipalities newly imbued with the spirit of improvement, are endeavoring to obtain from the experience of others better knowledge of paving. Hundreds of such letters have, within the last few weeks, been received by the editor of this publication. The widespread and growing interest on the subject, and the evident intention to utilize beneficially the knowledge gathered is one of the most encouraging signs of the times affecting the progress and prosperity of our cities, few of which to-day have streets that are in condition to adequately meet the requirements of traffic, leaving out of account other considerations that are important even though not commercial in character.

STREET sprinkling is done in Minneapolis by the city. The total cost last year of sprinkling 100 miles of street was $55,242.12. City Engineer Rinker, in his annual report, says: "I think I may safely say, without the fear of contradiction, that there is no work done by or under the direction of municipal authority that affords more comfort and satisfaction to the general public, and the cost of which is more willingly paid as a special assessment upon abutting property, than this work of street sprinkling. It not only furnishes immunity from dust, but makes the districts sprinkled more habitable during the summer months in which the work is required to be done, to say nothing of saving the housekeeper more in wear and tear of furniture, carpets, etc., than the cost of sprinkling."

ANDREW RINKER, the city engineer of Minneapolis, in his annual report which has just been printed, states that 80 per cent. of the street paving in Minneapolis is cedar block, and the remainder granite. The city has 24.622 miles of pavement, for which it has paid $887,980. The amount expended last year was $93,774. It is estimated that the expenditure this year will be $118,013. All of the city's paving has been done within the last eight years, the average being three miles for each year. Cedar blocks are now being used entirely. They are six inches long and from four to eight inches in diameter. They are laid on pine planks two inches thick, and the interstices are filled with gravel. No cement or paving composition is used.

AS an inducement to property-owners to build cement sidewalks instead of putting down other kinds, it has been proposed in the Kalamazoo board of aldermen that the city shall pay a rebate of two dollars per rod to all property-owners hereafter having cement walks made.

CHICAGO'S PAVEMENTS.

EXPERIMENTING with all kinds of pavement, Chicago has not as yet determined upon what material is best suited to her needs. Wood and granite block have had a trial and still form the principal roadways of the city. The former has the preference, as out of a total mileage of 350 there were 275 miles laid in wood, while stone had only 16 and macadam 31. In this branch of municipal work Chicago is decidedly behind other and less pretentious cities in the West, Cleveland to-wit. Many streets are well adapted to asphalt where the traffic is light, and the commissioner of public works may well direct his attention to the course adopted in New York, where the principal paving this year will be asphalt. Paris and London are good examples of what may be accomplished by the use of this pavement, which was adopted by New York only after an imperative demand from the people for a much needed improvement. As an excuse for the poor condition of the streets Commissioner Swift said:

"The department having in charge the improvement and maintenance of our streets meets with constant criticism, much of which is not merited. Subject to annoyances and obstacles that seem insurmountable, it is impossible to accomplish satisfactorily all that is desired in the work.

"The constant tearing up of street pavements and their improper and hasty relaying render it impossible to keep them in a good condition. Subject to the needs or wants of gas, telephone, electric and sub-

way corporations and private citizens, it is one continual round of tearing up and repaving, and yet unavoidable."

This obstruction is met with in every large city and yet comparatively good roadways are maintained. With a change of material no doubt such statements as the above will not be necessary in the annual reports of the department of public works.—*Fire and Water, Chicago.*

THE MOVEMENT FOR BETTER ROADS.*

By Col A. A. Pope.

THE construction of the public road is eminently a matter of the first and highest importance to any people. The first evidence of habitation looked for in a newly-discovered land is the trace of the foot print of a human being, whether in the scattered tracts of some casual explorers who have gone away again, or the beaten paths of those who have made it their home, and already have their established settlements with regular routes between them. Communication between one point and another is the idea standing first in the mind of the settler, after that of the building of his home, and we see the progress of the idea developing with the country, from the "blazed" line through the otherwise trackless forest, then the bridle-path over the roughly cleared way; following this the gradual stages of growth of the road proper, from that unregenerate condition which probably gave rise to the theory of the "survival of the fittest," because it would kill any ordinary mortal to ride over it, to MacAdam's perfected road, and the splendid sheet asphalt which it is the privilege of some of us to enjoy to-day. The establishment of communities, and of intercourse between them, come before the formation of government.

A prime function of government, is the protection of the life and property of the citizen, and I maintain that very high among the duties of a general government should come the construction and maintenance of roads, which shall serve in the best possible way the interests and welfare of the general public. It is an unfortunate fact that our own general government has thus far taken little advantage of even that authority distinctly given it under the constitution, for the construction of post-roads. Still less has it used its right to go beyond this in the establishment of national thoroughfares, which could afford as good opportunities for military and all other movements, and would redound in all ways to the credit of the country, as do the magnificent roads of European countries. Constituted as our government is, covering infinite necessities of so great and prosperous a country, and necessarily a complicated one, with its system of state organizations below it, it can, perhaps, hardly be expected that every duty should have been fulfilled thus far, nor that even now a matter which has had so little attention as this question which is of importance to us, can be brought before our national Congress with such prompt success as to bring us, within a reasonable time, such improvements as thinking people are demanding to-day.

With the exception of railroads, no other distinct class of engineering represents so large an outlay as highways, and notwithstanding the vast amount of money now expended on roads, on account of the ignorance and waste, and lack of trained road-builders, it too often happens that we get little value for our money. In twenty cities the investment in pavements represents $250,000,000.

The pressing needs of the country, and the increasing requirements of the public, are such that it does seem by all means desirable to bring it up in proper form in each state, by legislative acts secure such provisions and organizations as shall result in the greatest possible amount of good, and by education bring the people to the point where they will demand skilled engineers, trained road-builders, and the best highways obtainable.

No small amount of work is already being done in this direction in several of our states, and the good results are already making themselves felt in many directions.

A bill is now before the New York Legislature, which provides for the nomination by the governor, with the advice and consent of the senate, of four competent citizens, two from each of the great political parties, who shall be commissioners of state roads. They are authorized to borrow on the credit of the state, $10,000,000, at a rate of interest not exceeding 3 per cent., the moneys realized to be applied exclusively for the payment of the cost of surveying, laying out and constructing state roads in the several counties not in cities or incorporated villages. The bill also provides for an annual state tax sufficient to pay the interest and redeem the principal of the loan within eighteen years. The act shall be submitted to the people at the next general election.

Another bill provides that the board of supervisors in every county in the state except New York and Kings shall have the power to declare main thoroughfares to be county roads, and thereafter such roads shall be cared for by the county. The supervisors are empowered to borrow money to build or repair roads and bridges, but in no case shall the tax exceed 3 per cent. of the assessed value of the property in the town. They are given power to open new roads and to acquire lands for that purpose, and have a map made showing the principal highways, which shall be filed in the county clerk's office. When roads have been in whole or in part macadamized by a town, such town shall receive a fair equivalent for the expense. The supervisors shall have power to regulate traffic and travel on county roads, prescribing the weight to be carried and the width of the tire of the vehicles to be used thereon. These two bills are supported by the New York State Roads Improvement Association, which numbers thousands of the best citizens of the state in its membership.

This bill will, if passed, insure the construction of many hundred miles of superior highways in the state of New York, and provide for the extension of improved highways from time to time, as they may be needed.

A somewhat simpler plan than this is provided for by a bill prepared for my own state, Massachusetts, and one, perhaps, less likely to meet with the usual opposition from the many voters of the farming districts, who are too apt to look only at the expense of any reform or progressive movement without stopping to calculate the greater return it will bear them. It is proposed in this, that a commissioner of roads and bridges shall be appointed, who shall be a civil engineer, and receive a salary of $3,000 per annum and be allowed $2,000 for expenses. His duties shall be, to visit annually the cities and towns of the state, inspect the roads and bridges thereof, and advise the local authorities in relation to the same. He shall have general advisory oversight over the roads and bridges of the state, can be consulted at all reasonable times without charge by officials, and advise them as to construction and maintenance. He shall make an annual report to the legislature of his doings, and all facts collected, together with suggestions regarding the improvement of the condition of roads and bridges. The advantage of this plan is seen in the fact that no increase of taxation is called for beyond the $5,000 annual expenses, but it provides particularly for the judicious use of every dollar already expended on the roads, and aims at making such use of the materials and opportunities already at hand, under the guidance of well-qualified and competent officials, that without an increase of expense, roads which are now a disgrace to so thickly populated a community shall become a credit to the commonwealth, and shall increase the value of the property of every citizen, and add vastly to the comfort and welfare of all who have occasion to travel upon them. Under the old plan, still in vogue in many states, of permitting any one to work out a part or all of his road tax, too often more harm is done than good to the roads, and certainly it is safe to say that less than one-half of the amount of the tax is seen in actual effective results, so that the effect of the Massachusetts bill should be to secure a saving rather than an extra expense to the state, with rapidly-improving roads as a result.

"What we complain of, under the present condition of affairs," says a citizen of the state of Connecticut, who is already thoroughly interested in the road question, "is that all four of the wheels of our wagons are often running on different grades. This kind of a road, if a body tries to trot any, is apt to throw a child out of its mother's arms. We let our road-menders shake us enough to the mile to furnish assault and battery cases for a thousand police courts."

It is clearly recognized by the framers of both these bills that better roads benefit every one who rides, drives, or walks over them, bring farmers nearer to market and to railroads, increase value of taxable property by inviting the best people to settle in town, are of incalculable benefit to the general public, and saves wear and tear on vehicles.

A project is on foot in Jackson county, Missouri, to raise $1,500,000 to macadamize 300 miles of road in the county, and thus connect all the principal towns with Kansas City.

In Pennsylvania, where the importance of the matter has already been recognized and provided for to the extent of the levying of a special state tax for road purposes, a plan has been adopted, which, while intermediate in itself, may result in reaching the end aimed at even more quickly. In April last, the legislature adopted a concurrent

*An address delivered at the Street-Paving Exposition, held at Indianapolis, by Col. A. A. Pope, of Boston.

resolution providing for the appointment of three senators by the president of the Senate, five Representatives by the speaker of the House, and five competent citizens by the governor, as a commission to revise and consolidate the laws relating to the construction and improvement of the roads and public highways of the commonwealth, and to consider the advisability and practicability of the state assisting in the construction of the same, with power to prepare and present a bill providing for the constructing and maintenance of high class roads. The commission was appointed, of men of high standing in the state and noted for their practical ideas, and many of them for the broadest possible experience in just such works and matters as their special duties will bring before them, and they have been in session at Harrisburg in the prosecution of their work.

In Maryland, and Ohio as well, measures are already being entered upon, and the little state of Rhode Island is making most commendable efforts in the proper direction, under the impetus and guidance of some of the most prominent men in the state.

Not only such movements as this are being pressed, but the educators of the country are doing no small amount for the furtherance of the movement.

In Vanderbilt University, Nashville, Tenn., for instance, a course has lately been established for the instruction, without charge, of a class in road engineering, to which is admitted one highway official from every county in the state. This course consists of lectures and work upon the principles and science of the proper location, construction, reconstruction and maintenance of roads, and a thorough study of systems of highway ministration.

A valuable lecture delivered at Brown University, and a course of twelve lectures has been delivered in the Lowell Institute course in Boston. These are among the notable efforts being made by speakers and educators to do their share in the good work, and to educate the public up to an appreciation of what their rights and necessities are in this direction.

To quote again from the good citizen of Connecticut, to whom I have already referred, for he seems to have come pretty close to the gist of the matter: "How can we expect civil service reform in high places, while with outrageously false pretences we are continually taking the people's money in these mud holes? It was settled at Springfield last summer, and with wisdom, I think, that future probation is dubious. We need to behave, you see, so that we can be forgiven in this world for what we do, but I'm afraid some of our road-menders rely too much upon the future. The church has a deep interest in Connecticut roads—much too deep between country churches."

Well, the old ways are the prevailing ways yet, and what we want to do, as citizens of to-day, is to bring the public into a keen realization of the need of new road laws.

It has become the manifest duty of every state to provide by legislative act for the making and improving of the highways. The form of organization best adapted for your own state can be more readily determined upon by yourselves than by any outsider, but it would appear that between the establishment of a board of commissioners and the creation of a professional and practical state superintendent of roads, the latter would seem the more desirable plan. Under the charge of this head, an effort should be made at once in the direction of improving certain of your main thoroughfares already in existence.

Governor Hill, of New York state, in his annual message for 1890, has dwelt with much emphasis on the needs of the state for better roads, and he has recommended the passage of such an act as shall provide eventually two improved roads, north and south, through each county, so connected and running together as to form a net work of, as nearly as possible, perfect roads over the whole state.

While this may not be the best for every state, yet some general system by which the cities and larger towns should be connected by at least one good road between each, would be advisable, and in time these could be so added to, that every town and village could be reached easily and quickly by a perfect highway.

For the creation of these new roads, it is my firm conviction that the whole state should bear the burden, and that by the use of sufficient money without waste, these should be made model roads which shall redound to the credit of the state, and add to its prosperity, and unquestionably increase the total valuation of its property. So much for the needs and the duties of the state.

The curse of any pavement is the incessant disturbance to which it is subjected. The water and sewer departments, the gas company, the underground conduit people, and only too many others seem to feel it their divinely constituted right to raise havoc with the street surfaces at all possible times.

By the construction of a proper underground way a city may provide for the reception of all the pipes and wires that can possibly be needed for ages to come. Untold expense in future years can be saved and an adequate remuneration by levying tolls on private parties or corporations who need to use it for their special purposes can be secured.

For many other streets, where much travel and the lighter transportation is to be provided for, where stores and offices are numerous, and cleanliness and freedom from dust and noise are most desirable, nothing is better than sheet asphalt, laid as it should be, and for this I can but refer you to the prosperous and progressive Buffalo, where within eight years nearly one hundred miles of the best asphalt has been put down, and thousands of whose citizens bear the most willing and eager testimony to the advantages which have accrued to them from its use.

Who has not felt a pride, as he has traveled over those splendid asphalt streets of our nation's capital, where for miles in every direction one can walk or drive with so much comfort and pleasure? And when we reflect that twenty-five years ago the streets of our capital city were a disgrace to any civilization, and that now they are the best in the civilized world, you certainly may take courage.

In Detroit last year $9,100 were spent for asphalt pavement, and this year the mayor asks for $67,500 for the same purpose.

I find that there is being used to good advantage brick pavement, which is claimed to be cheap, durable, smooth, noiseless, and affords a sure foothold for horses. If it proves to be all that is claimed for it, it will he a great boon to our cities.

Outlying residence streets can for the most part be most suitably provided with macadam, but it should be better laid than most of them, and it should be kept in repair. Surely in nothing is the old adage about the "stitch in time" better applicable than in the case of city streets. Once properly constructed, they are the best and most cheaply kept in order, by constant watchfulness and prompt repair.

The great excellence of the English and continental roads and streets is undoubtedly due to their being properly made in the first place, but the satisfactoriness of their use, and the small per centage of cost of maintenance, is secured by their being kept constantly in order, at all times clean, and, as a minor feature, by being kept moist as constantly as feasible. The moisture of the climate in England is a great aid in keeping their splendidly constructed highways in order.

The cost of good roads has to be taken relatively, as the life of first-class paving is so much longer than of poor material. The average life of granite blocks in London, under heavy traffic, is about 15 years; of asphalt, 17 years. Captain Green says: "The relative first cost of granite and asphalt, as laid down in New York City, is $4.60 per square yard for granite and $3.75 for asphalt. The interest and sinking fund would amount to 27 cents per year for granite and 22 cents for asphalt. Annual maintenance would be 4 cents for granite and 10 cents for asphalt. In about fifteen years the total average annual cost per square yard would be only about 32 cents." It is estimated that the difference in first cost and annual repairs between good roads and poor roads will show a handsome surplus in less than thirty years in favor of the good roads, in addition to the advantages derived from the use of them.

There is also great economy in the saving of horseflesh by the use of the best roads. The force required to draw a load of one ton varies greatly, depending on the surface. The force required to draw one ton over iron is 10 pounds; over asphalt, 15; over the best stone blocks, 33; over cobble-stone, 90; over macadam, 100; over earth, 200. In New York traffic costs about 22 cents per ton-mile, but on asphalt it would cost about 7 cents. Or, stated in another form, if one horse can just draw a load on an iron tramway, it would take 1½ horses to draw it on asphalt, 3½ on granite, 9 on cobble-stones, 10 on macadam, and 20 on an ordinary dirt road. Thus it can easily be seen that there would be a vast saving in the number of horses, as well as in the longer term of service of those used.

There is a similar gain in the wear and tear of wagons. On an asphalt road a wagon would last many years longer, and cost less for repairs during the time, than on the rough pavements of most of our cities. The best paved streets draw the traffic from other streets, the asphalt taking the traffic more than any others.

But higher than the money economy stands the economy of brain, body, nerves and lungs. On brick or asphalt the noise is a low rumbling of the wheels, or the click of the horses' feet, but these sink into

insignificance in comparison with the roar of countless blows of iron shoes and wheel tires on cobble-stone pavements. Several eminent physicians have expressed the opinion that this incessant noise is the chief cause of the nervous diseases which have come to be such a feature of modern city life. There is no good reason why our business and residence streets should not become comparatively quiet.

A block pavement with joints sealed with gravel and pitch, or an asphalt pavement, gives a surface which absorbs no moisture and yields but little dust, affording a healthful road-bed for city streets, which can not be secured by any pavement that allows the filth to percolate through it.

It is clearly demonstrated by those most competent to make statements upon these matters, that given a properly constructed highway, and the proper system of care and repair, the total cost of construction and maintenance at the end of a reasonable term, say thirty years, will not materially exceed the cost of construction and the expense of maintenance of such streets as you are riding over to-day, to say nothing of the added comfort of using the former, the diminished wear and tear of your vehicles, and upon all living creatures, brute or human, who are obliged to make use of them, nor of the very great increase in the value of property.

Thus far I have outlined some of the ways in which city streets may be improved. Which pavement is best adapted for any one city can be determined by its own authorities after thorough and exhaustive study has been made of the subject. While one pavement would meet the needs of one city it would fail in another, and where a certain material could be used with economy another might prove ruinously expensive.

We boast to-day of the greatness and perfection of our railway systems, of their magnitude over those of any other country. Why do we not take as much pride in the building up and perfecting of our highways? If we should devote a part of the great energy now given to extending our railroads to improving our highways, it would not be many years before we should have the right to take a national pride in them.

TESTIMONY OF MUNICIPAL OFFICERS ON PAVING.

THE first question of the inexperienced, in undertaking the paving of streets, according to the best modern ideas, is very properly, "What can be learned from cities that have had experience?" The knowledge usually gathered is not always a sure guide to a positive opinion, but to those who in the beginning know little, it gives a better understanding of what they have undertaken, and if followed up with a careful study of methods, and if good engineering ability is called in to assist in reaching conclusions, it is not likely that any very serious mistakes will be made. With the exception of a few progressive cities, the municipalities of the United States are just now approaching an era of intelligent improvement, and to get the benefit of experience and opinion wherever they may be found is with the majority of them the first step. This desire for knowledge is promising, and is gratifyingly encouraged by the graciousness with which inquiries are usually answered by the municipal officers who are able to give valuable information.

Recently letters were addressed to forty mayors and civil engineers of cities in the United States, asking:

(1) What kind of paving have you found in your city to be the best in appearance and the most satisfactory for the various street uses?
(2) The most durable?
(3) The cheapest, comparatively, and the cost of making it in your city?

The answers that were received are given below briefly:

Albany, N. Y.—Our streets were mostly of cobble pavement until about four years ago, when we substituted granite block in most of our principal streets, and we have at the present time 16½ miles of granite block pavement, and our experience has been so far that it is the most durable and best pavement, and also the cheapest, on account of its durability.—*Edward A. Maher, Mayor.*

Baltimore, Md.—(1) For light work—that is, streets used only for carriages—we prefer the asphaltum blocks; (2) Granite Belgian blocks; we have paved streets for all the heavy work with this kind of paving; (3) from $2.35 to $3 per square yard. The paving and repaving of our streets are ordered in two ways, by action of the mayor and city council, and by request in writing from the proprietors of a majority of feet of ground abutting thereon, provided the commissioners shall give seven days notice in at least three papers. The approval of the mayor must accompany the action, and the mayor has also the right to sign the application on the part of the city when the corporation owns ground on the street in question. The work must be done by contract, the city commissioner supervising in every case. In repaving and resetting of curbs the city pays as in an original paving for the spaces where streets cross. It pays also for one-third of the street proper, the property owners binding thereon paying two-thirds; that is to say, those on each side of the street paying for the paving for the his lot one-third of the way across the street. Under this law a vast amount of repairing with Belgian and asphalt blocks has been done, the latter being patented blocks, composed of limestone, spoils and asphalt. Improvements have been made on the part of the city from a paving loan of $500,000 of 4 per cent. issued in 1881. The city will have paid upon redemption of the loan in thirty-nine years considerably more than the original loan, and were it not for the present pressure of taxes many citizens would favor regular appropriations for paving, as by the time the loan is due most of the streets will require paving again, and it is an improvement, the cost of which can not justly be put upon a succeeding generation as a permanent benefit. Many property owners have resisted payment, especially those who did not petition for the improved pavement, but a recourse to the law established the solidity of the law covering repavement by two-thirds, and the collections were enforced with interest.

Boston, Mass.—I am thoroughly discouraged about our macadamized streets with their enormous traffic. The traffic, present and prospective, is the basis to start from. For business streets granite pavement is preferable; for residence streets I would try asphalt, provided it is laid down in the best possible manner. Good pavements are very costly, but they pay if properly maintained. Not only teaming, but trade and homes go where the streets are in the best condition. In making streets as in securing a water supply, go for the best and pay for it.—*Thomas N. Nast, Mayor.*

Boston, Mass.—The best pavement for residence streets is sheet asphalt. The first cost of this is so great, as compared with macadam, that the latter is used almost exclusively in this city. Barber asphalt costs here $3.50 a square yard; macadam from 75 cents to $1.25 a square yard, varying with the thickness or whether a rubber foundation is put in or not. The maintenance of macadam is, of course, much in excess of asphalt, but I have no exact data to give on this point. I am, however, of the opinion that the cost of the macadam, through a series of years, will be less than asphalt, particularly on streets which are liable to be opened frequently for underground service. An objectionable feature of asphalt is its slipperiness in damp weather. On business streets, or streets subjected to heavy traffic, we use the large size granite blocks 10 to 11 inches long, 7½ to 8½ inches deep, and 3½ to 4½ in thickness. This pavement costs us $2.75 per square yard, and our custom at present is to bed the stones in screened gravel. A concrete base for the blocks would undoubtedly give better results in increased durability, but I have not recommended it here on account of the frequent opening of our streets for sewer, gas and water repairs, and supply the many new forms of underground service brought about by the various uses of electricity. We have 2.7 miles of asphalt; 8 miles of cobble-stone; 6.2 miles of granite blocks; 142 miles of macadam; and 159 miles of gravel streets and roads.—*J. Edwin Jones, Superintendent of Streets.*

Buffalo, N. Y.—There are in this city 194 miles of paved streets, of which 61 miles are asphalt and 132 miles are stone. In 1889 we put down 17½ miles of pavement, of which 11½ were asphalt and 6 were stone. In 1889 we put down 26 miles of pavement, of which 14½ were asphalt and 11½ were stone. The cost of the asphalt is $3 per square yard, and the stone costs about $2.75 per square yard. The first asphalt pavement laid in this city was in 1878. A large number of our residence streets are now paved with asphalt. With a few exceptions these pavements are now in good condition and the pavement is, I believe, popular. It has been put down on some of our streets in which there is heavy teaming done, and it stands the trial which it has thus far received, but these streets have not been paved long enough, perhaps, to warrant the indorsement of this pavement for such streets.—*Chas. F. Bishop, Mayor.*

Cincinnati, O.—(1) Asphalt, brick, wood and granite, for appearance, in the order named. Asphalt is almost noiseless, and is suitable for medium traffic. Brick is more noisy than asphalt; wood is less so; (2) granite block pavement is the only suitable material for heavy traffic; (3) asphalt, $2.85 per square yard; brick, $2.25; wood, $3.50; granite, $4 25. These prices include a six-inch concrete foundation, excavation for the same, rolling sub-grade, pitch joints and pavement complete in each case, to curbing or drainage included. These prices include keeping in repair for five years. Asphalt should have granite toothing along street railways, and tracks paved with granite where animal power is used. It should also have stone or brick gutters if house drainage is discharged into the street. Asphalt is adapted for residence and retail business streets. It stands travel about the same as brick and wood. Wood pavement I do not recommend. Granite is very noisy. It is important to lay a medium stone in hardness or the pavement will become slippery. Fire-clay paving blocks (brick) make a nice cheap pavement for moderate travel. This pavement is becoming popular. Our city has laid $4,000,000 of granite and asphalt during the past four years. The city paid one half the cost, or $2,000,000, the abutting property the other half.—*H. J. Stanley, Chief Engineer Board of Public Affairs.*

Chicago, Ill.—There are 355 miles of cedar block laid in Chicago, 19 miles of granite block, 4 miles of asphalt blocks, and 306 of macadam. The cost of repairs is provided for by a clause in the city specifications reserving six cents per square yard for two years, the contractor to keep the pavement in repair during that length of time after the completion of the work. For granite block pavement a reserve of 20 cents per square yard is retained for five years following the acceptance of the work. We have the same terms for sheet asphalt. If the pavements are in a thorough state of repair after the expiration of the time indicated, the contractor is then paid the full amount reserved. The city

then assumes the care of the repairs until the pavement is worn out, and an assessment ordered for repaving. Before the pavement is laid, it is the duty of the department to see that all underground connections are properly made. The width of our roadways are, on a 100-ft. street, 50 feet; 80-ft. street, 48 feet wide; 66-ft. street, 38 feet wide; 50-ft. street, 30 feet wide, and 49-ft. street, 28 feet wide.—*A. W. Cooke, Ass't Engineer, Street Dep't.*

Columbus, O.—Our main business street is paved with Georgia granite and Medina stone blocks. A number of streets, which are business and residence streets combined, are paved with a variety of brick and Hallwood or Hayden blocks. I think our experience will justify the opinion that *no* street ought to be paved with brick or any other material on account of being cheap. The best pavements are the cheapest. For strictly business streets, on which there is a large amount of hauling and especially heavy traffic, there is no doubt in my mind that stone blocks are the best and most durable. Next in order as to durability, and in point of ease of taking care and repair, the Hayden and Hallwood block would lead. Of brick proper we have a great variety, some made of fire clay, others of common clay, and again others made of a mixture of different clays, sand or ground stone. These are of variable quality, some are thoroughly vitrified, others partially, and still others are only common, hard burned brick. To those who have no direct experience in brick pavements it generally seems that brick pavements would be too weak a material and not sufficiently lasting and durable, but a glance at our pavements will readily disprove and remove that conclusion, and convince them that brick pavements have come to stay. I know of no other city that has so largely gone into the modern methods of street improvements as Columbus. Below you will find the rate per square yard of finished pavement as per bids offered for Fourth street. The improvement extends on said street for about 1,000–1,200 feet. The bids cover a sub-foundation of 8 inches broken stone, a course of sand two inches in depth and the superstructure of stone or brick, as the case may be, interstices filled with sand and hot pitch, and top dressing of sand:

Georgia granite, $3.50 per yard; Medina stone, second class, $2.80 per yard; Greenfield stone, $2.85 per yard; Massall fire-clay brick, $1.75 per yard; West Virginia fire-clay brick, $1.74 per yard; Middleport fire-clay brick, $1.66 per yard; Harris Bros. fire-clay brick, $1.88 per yard; Columbus vitrified brick, $1.72 per yard; Zanesville brick, $1.58 per yard; Hayden block, $2.15 per yard; Hallwood block, $2.16 yer yard; Canton brick, $1.79 per yard; vitrified brick, $1.79 per yard.—*Philip H. Bruck, Mayor.*

Denver, Col.—I think it is pretty well agreed that asphalt pavements, if properly laid, are the best in appearance and most satisfactory for the residence portion of a city. But I prefer stone for the business portions. Stone is the most durable. We have mountains of stone that we can use cheaply, and I have no doubt but that it is the cheapest material that can be used in every city. I have no doubt but that the business portion of our city will be of stone. I am unable to tell you what it would cost, as we have none laid as yet, and there have been no bids received, none having been called for. I regret we can not give you some information based upon the experience of the authorities, but we can not, and have done the best possible under the circumstances in the remarks above.—*Wolfe Londoner, Mayor.*

Grand Rapids, Mich.—Cedar blocks make the best appearing and smoothest surfaced pavement, lasting from seven to ten years, according to the amount of traffic over them. It costs about sixty-five cents per yard, exclusive of grading. In reply to the second question: We consider cobble-stone (the small one) the most durable, consequently the cheapest. We use the sapless cedar blocks, except on streets where the grade is steep; on such, we use small cobble-stone with satisfaction.—*John Killean, Mayor.*

Louisville, Ky.—(1) Granite and asphalt; (2) granite; (3) for light traffic, asphalt, $3 per square yard.—*Charles P. Jacobs, Mayor.*

Lowell, Mass.—This city has used two kinds of wood paving and they both failed. They lasted about eight years. The wood was saturated with a preparation; therefore the blocks did not rot, but were worn out. In dry weather the blocks shrink and then the joints fill with dirt and in wet weather swell, which throws the sidewalk curbing out of place. We have one street covered with tar concrete, and when new it makes a good pavement, but it costs too much to keep it in repair. We have come to the conclusion by experience that granite blocks (3½ to 4½, 9 to 12 and 7½ to 8 inches in depth), make the cheapest, most durable and best street travel for all kinds of traffic. We pay $42 per 1,000 blocks, and thirty-two blocks make a square yard. The granite paving laid costs from $2 to $2.25 per square yard. We macadamize some of our suburban streets, and the cost is about the same as granite paving, and costs far more to keep in repair, but it makes a better street for pleasure driving.—*George E. Evans, City Engineer.*

Memphis, Tenn.—(1) We have no pavements that for appearance, solidity, ease of traction and comfort equal or surpass the West Virginia vitrified paving brick laid on a nine-inch concrete foundation, two-inch sand cushion, then filled and surfaced with hot coal pitch (300°) and sand on surface. Average cost with us, $2.68 per square yard complete. This pavement, as we have laid it, is a splendid one, and will, I believe, prove a very durable one. (2) We have laid Arkansas and Missouri granite 4x6½ and 10x12-inch blocks on ten-inch concrete foundation, the joints filled with hot pitch and screened pea gravel. Cost $4.25 to $4.35 per square yard. Durability, under the heaviest traffic, estimated at fifty years. (3) The cheapest we have made are with stone gutters five feet wide, and road with concrete gravel, class E average about $1.75 per square yard.—*Niles Merriweather, Chief Engineer.*

Minneapolis, Minn.—Our experience can be very briefly stated, inasmuch as we have used two kinds of pavement only, granite block and cedar block, both of which have given good satisfaction. Granite, which is of course one of the most durable pavements, we have used on heavy traffic streets only. Cedar block is, with us, the cheapest for a comparatively durable pavement. Our contracts are let for the year's work at an average price of about $1.00 per square yard, which includes excavation. As an answer to your first question I would say that without question the best in appearance is sheet asphalt pavement, and I believe that when properly laid of the genuine asphalt, it is the most satisfactory for all street uses excepting, probably, for streets that may be used for speeding horses. The best residence street in our city will probably be paved with asphalt next year.—*Chas. O. Huntress, Ass't City Engineer.*

Nashville, Tenn.—Our Board of Public Works and Affairs have, for the past six years, experimented with several kinds of paving material, viz.: Ordinary hard brick, creosoted brick, bitumen concrete and granite, and they found that the cheapest and the best street that could be used was the granite. The first cost is somewhat large, but it is undoubtedly the cheapest street that can be used by any city, and especially where there is heavy and constant travel. Our city has adopted the plan of spending every year out of the ordinary revenue about $30,000 for granite streets. In this way we make good headway without the issuance of any improvement bonds. I would, therefore, recommend that you use granite.—*C. P. McCarver, Mayor.*

Newark, N. J.—(1) The paving which presents the best appearance is, in my judgment, the one which has the smoothest surface, and can be kept the cleanest. The first in rank would be asphalt, then wood, brick, granite block, etc. The most satisfactory for business streets, or where there is heavy traffic, is the oblong granite block paving, or the same in trap-rock. These ought to be set upon a concrete foundation, of suitable thickness, and the interstices between the blocks filled with pea gravel and paving mastic, both heated. This kind of paving put down in Fifth avenue, New York, cost $4.75 per square yard. In our city the blocks are simply put down upon an ordinary sand foundation, and the same material is used for a covering; first, on account of its cost, and secondly, because it is in constant danger of being torn up for the various kinds of connection, such as sewer, etc., which is very disastrous to any kind of paving, when not properly put back. Commissioner Gilroy, of New York, is now recommending to the city authorities to seek legislative power to give him absolute control over such work. (2 and 3) The most durable are, without question, the block pavings, and for this reason the cheapest in the end. The price paid for the last contract of oblong granite block paving was $2.80 per square yard; for oblong trap-rock block, $2.49; for square trap-rock block, $1.75; for Trinidad sheet asphalt paving, which the city recommended to be put down last year, the sum of $2.85 per square yard was paid. The distance covered is only one-half mile. There are also two short streets paved with the asphalt blocks, which cost $2.54 per square yard, laid on sand foundation. Ex-commissioner of Public Works of New York, Gen. John Newton, expressed his views that in cities where the streets are subjected to heavy travel, the block pavings ought to be resorted to, and in residential streets, asphalt. The first of our oblong granite block paving was put down in Broad street, in 1879. The block in which it was laid receives the heaviest travel in the city; it does not show much wearing.—*Ernest Adam, City Surveyor.*

New Haven, Conn.—Our experience here demonstrates that the proper pavement for any particular street depends largely on local conditions, and what is suitable for one street might be very unsuitable for another. For business streets subjected to heavy traffic the granite dimension blocks (with or without concrete foundation, depending on the soil) give the best results. It is the most durable of practical pavements yet devised, the chief objection being the noise. The cost here is about $2.50 per square yard. For streets of fine residences the Trinidad asphalt pavement, as laid by the Barber Company, gives good satisfaction. It is not as durable as granite, but is less noisy, more easily cleaned and much pleasanter to drive on. Its cost here is about $2.75 per square yard. For suburban streets and conditions which compel a cheap pavement, broken stone (trap or granite) is suitable—thickness six to twelve inches—depending on the soil. It is pleasant to drive on and cheapest in first cost, but the most expensive to maintain. The cost is from 50 cents to $1.25 per yard, depending on thickness.—*F. G. Hastings, Private Secretary of Mayor.*

Omaha, Neb.—Stone is absolutely the most durable and comparatively the cheapest. Asphalt is the smoothest, most pleasing, cleanest, but the most expensive. As to the best pavement for any particular street that is a much mooted question, and will be, I imagine, for many years to come. I will, however, give you my ideas on the subject. For heavy business traffic stone should be laid. For light traffic and residence streets asphalt will always be satisfactory if the people can and are willing to afford the expense. For a cheaper pavement for last mentioned streets first-class paving brick on a concrete base. The above might be elaborated and reasons given for the same, but it sums up in a few words the result of my experience.—*George W. Tillson, City Engineer.*

Patterson, N. J.—For main thoroughfares with heavy traffic nothing is so durable as granite or trap rock blocks, in shape either square or rectangular being the best. Such a pavement costs here about $1.50 per yard for square blocks and $2.30 per square yard for rectangular blocks. Such a pavement is greatly improved by laying on a foundation of concrete or broken stone, the cost being increased about $1 per yard. For private streets 4 inch macadam, properly laid and properly cared for, is an excellent pavement, but does not answer for streets with heavy and

constant traffic. This pavement costs about 40 cents per square yard. —*William Ferguson, City Surveyor.*

Philadelphia, Pa.—The best pavement in appearance and the most satisfactory is of granite block, or sheet asphaltum. The most durable is granite block. The cheapest, comparatively, taking durability into consideration, is granite block, which costs on an average of $2.50 per square yard laid.—*Louis Wagner, Director.*

Providence, R. I.—I am directed by the mayor to say that the material which has given the best results and proven the most satisfactory for paving in this city is granite block. In the business part of the city and in the highways where there is a heavy traffic these blocks are laid thoroughly on concrete foundations, while in outlying districts a sand foundation is found to be sufficient. The cost of this pavement is about $4.50 per square yard on concrete foundation (including the blocks) and about $2.75 per square yard (including blocks) on sand foundation. Streets that have been paved with asphalt and wooden blocks have not proven durable or given satisfaction, and cobble stones are fast being replaced by granite blocks.—*Charles K. Gibb, Mayor's Sec'y.*

Richmond, Va.—For heavy traffic prepared block paving has no superior. For light traffic granite spall paving, and for residence streets and pleasure driving gravel and macadam are best. The cost of these is as follows: Prepared block paving, $2.45 to $2.48 per square yard; spall paving, 95 to $1.03 per square yard; graveling (one foot in depth) from 15 to 20 per square yard, and macadam (one foot in depth), about 75 per square yard.—*W. E. Cutshaw, City Engineer.*

Scranton, Pa.—We have had experience in this city with only two kinds of pavements—cobble-stones and the Barber asphalt. We have, however, given the subject of paving a great deal of thought and attention, have sent special committees to examine different kinds of pavement in other cities, and have come to the conclusion that no other pavement combines as many good qualities with as few objectionable features as the Barber asphalt pavement. The cost per square yard, laid down in this city, with six inch concrete base and two inch asphalt covering is $2.65. We have about three miles of this pavement at the present time and expect during the coming season to put down almost as much more.—*Ezra H. H. Ripple, Mayor.*

St. Joseph, Mo.—We have laid about six miles of sheet asphaltum pavement and smaller amounts of granite blocks, cedar blocks and vitrified brick. The average cost per yard of each has been: asphaltum, $2.80; granite, $4.40; cedar blocks, $1.53; brick, $1.75. The first two include a six-inch concrete base. The cedar is laid on two-inch hemlock plank on a sand base. The brick has first four inches of sand, and finally a layer of brick on edge (four inches) in courses at right angles with the street; joints broken with half brick at curb lines. The bricks used are of ordinary building size, and are made here from clay especially adapted to this purpose, of which we have unlimited quantities of the best quality. While asphaltum makes, perhaps, the handsomest street, it is not proving as durable as was expected, and from the first has required quite extensive repairs. These repairs necessitate the maintenance of an extensive plant, and as they can only be made by experts, are very expensive. Cedar block make a smooth, pleasant pavement when first laid, but it is short-lived and soon becomes rough and uneven. The brick, as laid by us, has all the advantages of the others, with several additional. While it is equally smooth and noiseless, it affords a much better footing for horses. Its first cost is much less than granite or asphalt, and but a trifle more than cedar. We believe it to be equal to any of the others in durability, and superior to all, unless it may be the granite. It is superior to all in the ease and cheapness with which it can be repaired, and taken up and replaced for making pipe connections, etc. Of course the cost will depend largely on the proximity of suitable material. Unless the distance is so great as to increase the cost of the brick beyond reasonable limits, I believe it to be the best and most economical pavement now known. The prices given above do not include curbing or taking up old paving or macadam or proportion of a roadbed, which will cost about the same in either case. Under our law, pavement is only to be laid upon petition of property owners, and the total cost, including intersections, is charged direct to abutting property in proportion to frontage, the contractor taking his pay from the city in special tax bills. The indications are that nothing but brick will be called for the coming season.—*M. J. McCabe, City Engineer.*

St. Louis, Mo.—The experience of this city makes granite pavement the most desirable from an economic point of view. The first cost of granite, asphalt or treated wood, all on concrete base, are about the same—$35 to $40 per square of 100 superficial feet. Wood will require complete renewal within ten years, asphalt needs costly repairs within a few years, but the repairs on the granite are merely nominal for a period of about fifteen years. Where there is heavy traffic, granite is unquestionably best.—*Geo. Burnet, Street Commissioner.*

Troy, N. Y.—For about eighteen years granite blocks alone have been used for street paving in this city. The Nicholson wood pavement and the Scrimshaw pavement were a rank failure and our people turned from them to granite blocks. This last certainly possesses the quality of durability, and situated as we are within a comparatively short distance of the quarries the cost of pavement has not been large. It has ranged between $2.45 to $2.90 a square yard, with from ninety cents to a dollar a running foot to be added for 20-inch curb stone set in connection with the pavement. This stone pavement, however, is very noisy, and in an age in which people are becoming more intelligent and more and more of the comforts and conveniences of life are demanded, it is hard to think of an entire town being paved with stone. Fire brick has been strongly recommended to us from a number of places. So has asphalt as now laid. Our common council has recently ordered two blocks to be paved, one with brick and the other with asphalt. It is said that improvements can be made in the way of granite pavement which will, to some extent, render it less objectionable than it is, viz.: Place the blocks closer, have them cut cleaner and lay in asphalt between the spaces. We are going to try this within a little while. The putting in of the asphalt will help preserve the bed for the blocks and will keep out the foul matter which falls upon the streets and which, where the filling between the blocks is gravel, is retained only to be given out by moisture and heat.—*William J. Roche, Comptroller.*

Wilmington, Del.—We consider asphaltum block paving the best in appearance and most satisfactory of any paving in Wilmington, although Belgian block are the most durable. The cost of Belgian block paving is about $2.25 per square yard, and asphaltum block paving about two or three cents less than that. We find asphaltum block paving unfit for steep grades.—*T. L. Carpenter, Sec'y Street and Railway Department.*

Wheeling, W. Va.—We think there is no better or cheaper pavement made than brick. The only question with us is, not who wants it, but who can get it first.—*W. Seabright, Mayor.*

A COMMITTEE'S REPORT ON PAVING.

SEVERAL weeks ago the Detroit common council authorized a committee to visit different cities and thoroughly investigate methods of paving, and present a report embodying the information gathered, together with recommendations. The report was one of the most intelligent ever made by a municipal committee, and is here given in full:

Granite.—Your committee found granite used as a street paving material in Cincinnati, 28½ miles, St. Louis, 39¼ miles, and Chicago, 11 miles. There have been in use several kinds of granite, quarried in Georgia, Missouri, Wisconsin and Minnesota, in Chicago. We ascertained that the hardest kind of granite made a somewhat slippery pavement, and in Cincinnati were discarded for a softer quality of granite. The foundation in each of those cities was composed of six to eight inches of concrete, the blocks being laid on a cushion of three (3) inches of sand. The cost of this pavement varies in the different cities. St. Louis and Chicago pay $3.52, and Cincinnati has paid as high as $4.50 for dressed Georgia block. All granite pavements are filled with an asphaltic composition so as to make it impervious to water. This pavement, so laid, has been found to be practically indestructible.

Medina Stone.—First-class Medina stone is a very durable and a comparatively smooth pavement, and not being so hard as granite, is not so slippery. It has been found to wear very evenly and is especially adapted to heavy traffic.

Brick.—We found brick as a paving material in use in Cleveland, Columbus and Decatur. Cleveland has made some experimental tests as to the wearing qualities of brick of various manufacture, but as yet only laid one public street with this material. The tests were made by the city engineer and were as follows: Absorption of water; the grinding test and the tumbler test. Medina sand stone was taken as the standard. The absorption of water in 48 hours in Medina stone and a West Virginia brick known as the "Porter Union" was the same and was scarcely perceptible. The grinding test consisted of placing the specimens on a grinding table, under a 50-pound weight, and grinding them with sharp sand and water for three hours. The third and severest test consisted of weighing the samples and placing them in a tumbler three feet in diameter together with 15 irregular shaped castings. The tumbler was then put in motion revolving at the rate of 20 revolutions per minute, and was run for one hour. The largest pieces of each sample were then weighed and the percentage of loss noted. The result showed that the Porter Union was only slightly inferior to Medina stone. The Canton fire-brick and the Hayden block did not withstand the test as well as the Porter Union. The public street spoken of is Euclid Place. It was paved with Canton, O., fire-brick four years ago and is still in excellent condition, showing very little wear or disintegration. It cost $1.62 per square yard, and is laid on 12 inches of sand. Several of the private streets in the residence portion of the city have been laid with brick, principally the Canton fire-brick, and the pavements seem to have given good satisfaction. The price ranged from $1.35 to $1.75 per square yard. In Columbus we found 21 miles of brick pavement, all of which has been laid in the last six years. The residents claim that seven years ago this was one of the worst paved cities in the country, and it impresses your committee as being now one of the very best. The brick in principal use is what is known as the Halwood block. It is made of a mica shale mined about 50 miles from Columbus, ground to a fine flour, sifted, mixed with water, pressed, dried and thoroughly vitrified by burning. The factory is located in the suburbs of Columbus and cost $125,000, the owners being the Ohio Paving Company. The block is a large one, taking 45 to the square yard to 65 of the ordinary brick. The company have such confidence in the wearing qualities of this brick that they proposed to your committee to lay it in Detroit for $2.50 per square yard, with a 10 years' guarantee on business streets and a 20 years' guarantee on suburban streets. This pavement is laid on a foundation of eight inches of broken stone, rolled with a 10-ton roller and two inches of sand for a cushion. The joints are filled with boiling pitch. The streets of Columbus are in excellent condition and impressed your committee very favorably with brick as a paving material. No repairs whatever have been made during the six years in which brick has been used. The resisting power of the

brick was shown to good advantage between the street car tracks where it was subject to the greatest and most constant wear: The price of brick paving in Columbus ranges from $2.25 to $2.50 per square yard, and includes a foundation of 10 inches of broken stone. In Decatur, Ill., the system of laying brick is entirely different and the cost much less than in Columbus. The brick is of ordinary size, 2 x 4 x 8, and the the sub-soil is clay. Four inches of sand is laid, then a flat layer of brick, then a cushion coat of two inches of sand, and then the wearing surface, which is of vitrified brick laid on edge. There are eight miles of this pavement here, and not more than $50 has been paid out for repairs in the five or six years it has been laid. The first street was paved five years ago with the ordinary common hand-made brick, and even this is expected to last from two to three years longer, though the material of which it is laid is now discarded. The best pavement costs from $1.50 to $1.70 per square yard, with brick at $9 per thousand for selected brick, and $8 for the average run. It is the opinion of the Decatur brickmakers, who have tested the clay in the vicinity of Detroit, that it will make fully as good, if not better brick than the Decatur clay, and it is believed that it will cost less per thousand here than there.

Asphalt.—Your committee found asphalt in use as a paving material in Buffalo (61 miles), Columbus (10 miles), Cincinnati (6½ miles), St. Louis (4 miles), and Chicago (4 miles). This does not include a large amount of asphalt pavement on boulevards in Chicago under the control of various park commissions. The present specifications for asphalt paving provide a 6-inch concrete foundation, a 4-inch tile drain under curb, and a 2½-inch wearing surface of asphalt composition. In Buffalo can be seen all kinds of asphalt pavement, from the best, which has lasted 12 years without repair, to the poorest, which has had to be repaired constantly since it was laid. One thing noticeable about asphalt pavement here is that it had all been paid for by the property owners in their petition; that they keep on asking for it on other streets, and that wherever it had been laid properly has been considered more desirable and has brought higher prices when sold. There are here about 51 to 52 miles of very good asphalt to which there seems to be but one objection, that of being slippery when covered with a thin film of ice. Asphalt pavement is laid here under a guarantee of five years, which in some instances has been extended to eight years. This kind of pavement has certainly done much to beautify Buffalo and make it an attractive city. One thing we discovered to be desirable in the case of asphalt was to clean it with only a light sprinkling, as the use of too much water has a tendency to cause disintegration. Our observations concerning asphalt in other cities showed substantially the same results: an appreciation in the value of abutting real estate, and a tendency to beautify the cities in which it was laid.

Wood.—We found no wood pavement in Buffalo, three miles in Cleveland, none in Columbus, 2½ miles in Cincinnati, five miles in St. Louis, none in Decatur, 470 miles in Chicago. Cleveland had a considerable amount of wood pavement, and for the past ten years has done little else in the paving line than to tear up the wood and replace it with Medina stone. St. Louis is putting down some cedar block pavement, but on a concrete foundation. If this does not last the blocks will be taken up and granite substituted. All the pavement at Chicago was at one time of wood, but it was found to be unable to withstand the heavy traffic in the business districts, and much of it there has been replaced with granite. The large amount of wood pavement now in Chicago is laid in marked contrast to the system in vogue in Detroit. Some attention has been paid to the foundation, and the specifications call for either six inches of broken stone or four inches of sand and two-inch hemlock plank. The blocks are laid better, being filled with fine roofing gravel rammed in and filled with boiling tar. The result is that Chicago has had wood pavements that have lasted with repairs from five to twelve years, according to the amount of traffic.

Macadam.—Your committee found macadam to be in use as a paving material in several of the cities visited, but the concensus of opinion seemed to be that while desirable for boulevards and park roads, it did not make a good city pavement.

Miscellaneous.—We found several other kinds of pavements, such as cobble-stone, limestone, etc., but as they had been tried and found wanting we do not consider it necessary to dwell upon them.

Recommendations of the Committee.—Your committee are satisfied that no good pavement of whatever name or nature can be laid without a good foundation. They therefore recommend:

(1). That no pavement in future be laid in Detroit without a six-inch concrete foundation and four-inch tile drain under the curb.

(2). That all pavements except asphalt have not less than a two-inch cushion coat of sand on the concrete.

(3). That curbstones, whether of Medina or Berea stone, be not less than four feet in length, not less than 18 inches in depth and four or five in thickness.

(4). That first-class Medina stone with filled joints be used on all very heavy traffic streets.

(5). That asphalt be used to pave the main thoroughfares where the traffic is not too heavy and on fine residence streets, and that brick be used on other residence and suburban streets.

(6). That where wood pavement be used the joints shall be filled with fine gravel and cement, making the surface water-tight.

(7). That Medina stone, brick and asphalt be used for all repairing.

(8). That no pavement of any kind be laid hereafter without a five years' guarantee.

(9). That no paving be done on any street until all water, gas and sewer connections have been made, and that a proper ordinance to enforce this recommendation be adopted and strictly enforced.

Supplemental to the report of the committee an address was delivered by Mr. Oren Scotten, a member of the Board of Estimates, in which he said: "It seems to me that we can safely prescribe a certain definite base for the different kinds of pavements; namely, a concrete base of not less than six inches in thickness, which will be of substantial value for the different kinds of wearing surfaces and for an indefinite period, so that a mistake made in the adoption of a wearing surface would not be so vital as where a pavement was laid that failed entirely with the top. Therefore, gentlemen, for one, I desire to go on record in advocating a uniform base for all pavements; namely, six inches of concrete. I will say that I have not alone formed this impression from my limited observation, but from a knowledge of the specifications for street paving in European cities, which is almost uniformly a concrete base, differing from my suggestion only in that they there prescribe even more than six inches." Mr. Scotten, speaking for himself, expressed a preference for asphalt.

DETROIT'S METHOD OF CEDAR BLOCK PAVING.

THE specifications for cedar block pavements adopted by the council require that coal tar be poured over the gravel which is tamped between the blocks. Coal tar was formerly used in this sort of pavement, but no one was able to give any better reason for its use than that it furnished a market for the refuse of the gas companies. It was at last abandoned, and its absence was co-incident with an improvement in the pavement. It has no adhesive quality so far as the gravel is concerned, and as the gravel is required to be composed exclusively of pebbles, it will have no cementing quality in itself. The consequence will be that the water will run freely through the pavement and there will be an under drainage which will lift the blocks out of place.—*Detroit News.*

A NEW PAVEMENT IN GERMANY.

A NEW pavement, which is finding favor in Germany, is formed by first laying a bed of concrete from four to six inches thick, over which is laid a mixture of asphalt and powdered granite to a depth of about half an inch, and then broken granite in cubes of one to two inches, the joints being filled also with a mixture of asphalt and powdered granite.—*Journal of Commerce, Chicago.*

Cut this out and send it to PAVING AND MUNICIPAL ENGINEERING, 44 Chamber of Commerce, Indianapolis, enclosing one dollar.

....., 189....

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Paving and Grading.

Patoka, Ind., is interested in brick paving.

State street, Newburyport, Mass., is to be paved.

Oregon street, in Milwaukee, will be paved with stone.

Grant county, Ind., will build several gravel roads.

Clay avenue, Scranton, Pa., is to be paved with asphalt.

Numerous streets will be paved at once at Davenport, Ia.

Farmer City, Ill., will construct numerous brick sidewalks.

North Peoria, Ill., will pave Knoxville avenue with brick.

Bolton avenue, Cleveland, will probably be paved with brick.

The streets of Evansville, Ind., are being paved with brick.

Bancroft street, at Port Huron, Mich., will be paved at once.

At Elgin, Ill., River street will be improved with cedar blocks.

Kirkwood, Mo., has sold $10,000 of street improvement bonds.

Mechanic street, Cleveland, will be paved with vitrified brick.

Two new paving districts have been created at Little Rock, Ark.

Asphalt paving will be used on Park avenue in Minneapolis.

County road improvement is being strongly agitated at Cairo, Ill.

Boise City, Idaho, citizens will build a wagon road to Minersville.

New Lisbon, O., has voted $30,000 of bonds for street improvements.

Extensive street improvements will be made at Greenville, Ala.

Two miles of sidewalks have been condemned at Bay City, Mich.

A wagon road will probably be built from Butte, Mont., to Champion.

The Cleveland (O.) council has ordered the pavement of several streets.

Military street in Port Huron, Mich., will be paved with cedar blocks.

Extensive street paving, possibly asphalt, will be done at Sandusky, O.

Second, Third and Fourth streets, in Fond du Lac, Wis., will be paved.

Olive street, at Stillwater, Minn., will be extended at a cost of $12,000.

West Third street, in Little Rock, Ark., will be macadamized with granite.

Streator, Ill., is considering the better pavement of the streets of that place.

Ionia street, in Grand Rapids, Mich., will probably be paved with asphalt.

Annapolis street, in St. Paul, Minn., will be graded by the state, at a cost of $40,000.

Ordinances have passed the council for improving several streets at Kokomo, Ind.

Franklin Square, Rock Island, Ill., will probably be improved at a cost of $2,500.

The Savannah, Ga., council has been petitioned to pave Drayton street with asphalt.

Montgomery and Tippecanoe counties, Indiana, will build an eleven-mile gravel road.

Ordinances have passed the council for the grading of about one hundred alleys in Omaha.

Sundry streets are to be laid out and some macadamizing is to be done at Providence, R. I.

Chicago street, at Tecumseh, Mich., will probably be paved. Material not decided upon.

Concrete walks will be laid in the new park at Cedar and Hammond streets, Bangor, Me.

Several streets will be paved with cedar blocks and brick at Detroit, at a cost of $40,000.

The Omaha, Neb., council has passed ordinances for an immense amount of street paving.

Sinclair street, McKeesport, Pa., is to be paved with Belgian blocks, and otherwise improved.

The commissioners of Port Townsend, Wash., will improve the county roads, at a cost of $40,000.

The Des Moines Board of Public Works has advertised for bids for paving Ninth avenue with brick.

Fire Chief Jackson recommends the use of asphalt floors in the department stables at St. Paul, Minn.

Davenport, Iowa, has undertaken to put down sidewalks on a uniform system throughout the city.

Tampa City, Fla., has passed a resolution to appropriate $28,000 for the improvement of several streets.

The St. Joseph, Mo., city council has decided to use no more macadam, and will consider other material.

At Springfield, Ohio, bids will be received to June 28, for furnishing material and paving several streets.

At Detroit, Mich., Gratiot avenue will be widened. Second avenue will probably be paved with asphalt.

Kail street, Black Rock, N. Y., is to be paved with asphalt. Other streets have also been ordered paved.

The Holyoke, Mass., Park Commissioners advertise for bids for laying concrete walks in New Hamilton Park.

The contract for improving Bonson street, at Grand Rapids, Mich., has been let to Richard Pickett for $3,345.

The city engineer of Clinton, Iowa, has been ordered to prepare plans for a large amount of grading and paving.

The Folsom Street Improvement Club, of San Francisco, contemplate extensive improvements for that street.

The Little Rock granite company has been awarded a contract for paving and grading district No. 24, at $7,114.50.

A fine boulevard will probably be constructed from Fort McPherson to Piedmont Park, eight miles, at Atlanta, Ga.

The Columbus, Ohio, council has ordered the street railway company to pave between its tracks with Hayden blocks.

A rock asphalt pavement is to be put down on Congress street, in Portland, Me., by the New England Paving Company.

Pine street, in Atlanta, Ga., will be paved from W. Peach street to Calhoun street with granite block, at a cost of $7,000.

Col. Eugene Robinson has been awarded a contract for paving Putnam avenue, Detroit, with asphalt, at a cost of $43,000.

The Waltham, Mass., council has been petitioned for concrete sidewalks, on Wardsworth avenue and on Adams street.

The Summit Avenue Boulevard and Park Association, of St. Paul, is taking active steps for the improvement of that avenue.

Wm. Forestall, of Milwaukee, has been awarded a contract for furnishing 400 square yards of granite block at $1.78 per yard.

The Barber Asphalt Paving Company has been awarded contracts for over $100,000 worth of asphalt paving in Albany, N. Y.

Contracts for street paving at Fond du Lac, Wis., have been left to John Schumacher, John Gill, F. W. Ingram and L. Lamouthe.

At Lowell, Mass., H. E. Fletcher & Co., of West Ford, have been awarded the contract for furnishing 200,000 granite paving blocks.

W. H. Tawr, S. George and John Lauck, of the Wellsburg, W. Va., Board of Public Works, will receive proposals at the bank of Wellsburg, until June 21, for grading and paving with fire brick, a part of Charles street.

The question of extending Marshall street, at Philadelphia, is agitated, and an ordinance has been introduced in the council to that effect.

The Beatrice, Neb., city council has let the contract to J. S. Rutherford for paving districts 4 and 5 with brick, at $1.44 a square yard.

The aldermen have appropriated $5,000 for grading the grounds and paving about the new contagious diseases hospital, at Brooklyn, N. Y.

Extensive street work in the way of flagging the streets and curbing of gutters, has been ordered by the Lansingburgh (N. Y.) council.

Considerable grading, paving and other street improvements, and laying out of new streets, has been asked for in the Pittsburgh council.

The Newark, N. J., council has been petitioned to pave Bellville avenue with asphalt, and an ordinance has been introduced for the paving of Garrison street.

The Lincoln, Neb., council has adopted resolutions authorizing the board of public works to advertise for bids for the paving of the streets in District No. 15.

The Chicago committee on streets and alleys south, has recommended the passage of an ordinance for widening Michigan avenue one hundred feet at its southern extremity.

The Rockville, Conn., Committee on Public Works and Streets is seeking estimates for the paving of Market street with granite blocks, asphaltum, and also macadamizing the same.

W. W. Mines, has been awarded the contract for grading Vine, Elm, and a portion of Eighth streets, in Camden, N. J. The street committee has adopted a resolution rescinding all ordinances for the paving of streets with asphalt blocks.

The people of Aurora, Ill., are in doubt whether to pave their streets with cedar blocks or brick, and at the invitation of Supt. Johnson, of the C., B. & Q. road, have decided to visit some of the leading brick manufactories before reaching a final determination.

Water-Works.

Lamar, Mo., will build water-works.

Water-works will be built at Eaton, Ga.

Guthrie Center, Ia., will put in water-works.

Water-works will be built at Washington, Iowa.

Lebanon, Ind., has voted to build water-works.

Madison, Ga., contemplates building water-works.

Franklin, Mich., will probably put in water-works.

Trenton, Tenn., has voted to build water-works.

Water-works will be put in at once at Greenville, S. C.

Elk Rapids, Mich., is agitating for a water works system.

Water-works, to cost $50,000, will be built at Albany, Ga.

Water works will probably be put in use at Forest City, Ark.

Huntington, Ind., will let a contract for water-works at once.

The Springfield, O., water-works will be extended to cost $5,000.

Water-works are being built at Imlay City, Mich., to cost $18,000.

A reservoir is to be constructed at Toronto, O., at a cost of $18,185.

The Topeka Water-works Company will considerably extend its mains.

The Lake View water tunnel, at Chicago, will probably be extended.

Hillsboro, Ill., will build an additional reservoir at the water-works.

The water-works of Wasso, Mich., will be extended at a cost of $20,000.

Zanesville, O., will issue bonds for $50,000 for water-works improvements.

The water-works company, at Menominee, Mich., will erect a pump house.

Fort Russell, Wyo., is making a $12,000 addition to the water-works system.

The Miles City, Mont., electric light company will erect water-works at once.

Carthage, O., will issued bonds for $20,000 for the construction of water-works.

H. Winchell has bought the Le Mars, Iowa, water-works, which will be extended.

Zanesville, O., will issue bonds for $50,000 for the improvement of the water-works.

The Oshkosh Water Works Company will make extensive improvements to its system.

The Charleston, S. C., Water works Company will probably make extensive improvements.

The Cleveland, O., water-works trustees may extend the new lake tunnel 10,000 or 12,000 feet.

The question of building water-works, to cost about $20,000, at Alliance, Neb., is being agitated.

The Ansonia, Conn., water power company will at once commence to lay pipes on North Main street.

Burlington, Ia., will probably make a contract with the water company for an improved water supply.

The Deland, Fla., city council has granted a franchise for water-works to J. W. Starr, of Philadelphia.

J. E. Keelyn, of Chicago, has made a proposition to construct water-works at Redwood Falls, Minn.

The Keokuk Hydraulic & Electric Co. contemplates developing an immense water power near Keokuk, Iowa.

The Missouri River Power Company, of Helena, Montana, will build a water-works plant to cost $500,000.

The Bonham, Tex., city council has appointed a committee to survey the city for the laying of water mains.

C. L. Parker, of St. Augustine, Fla., will probably be given the contract for water-works at Florence, S. C.

The Mammoth Springs Water, Light and Motor Company is building water-works at Mammoth Springs, Ark.

Snyder & Williams, of Dayton, O., have the contract for the water-works at Hudson, Mich., to cost $23,673.77.

City Engineer Norway, of Chicago, reports that 50 miles of new water mains will be laid in Hyde Park this season.

An election will be held on June 23, at Fargo, N. D., to vote on the issuance of $80,000 of water-works bonds.

The Tekamah, Neb., council is considering an ordinance for the holding of an election to vote on water-works bonds.

The Dalles, Ore., council has ordered the water commission to commence the construction of water-works at once.

The Mountain Water-works Construction Co., of Denver, will increase their capital stock from $500,000 to $1,000,000.

The water company at Olympia, Wash., will build a new reservoir to cost $14,000 and have a capacity of 1,500,000 gallons.

Engineer F. C. Gunn, of Kansas City, has charge of the 15,000,000 gallon reservoir now in course of construction at Leavenworth, Kansas.

Mayor E. R. Clark, chairman; Aldermen Van Blarcom and Waite, F. E. Morgan and W. A. Coones, constitute a committee to have in charge the contemplated water-works at Coldwater, Mich., for which bonds will be issued.

The work of extending water mains at Glenn Falls, N. Y., will be commenced upon the disposition of water bonds recently authorized.

An eastern company has asked a franchise for water-works at Carmi, Ill. If granted, they will lay seven miles of pipes and furnish fifty fire plugs.

John Nicoll, of Chicago, employed by Sioux City, Ia., to investigate the water-works of that place, has reported in favor of a new system to cost $300,000.

The Oshkosh, Wis., water-works have been sold to a syndicate of eastern capitalists. W. J. Maxoy is president of the new company. Improvements will be commenced at once.

The board of directors of the Sunset Irrigation District, Fresno, Cal., will issue $80,000 bonds for the construction of a canal one hundred feet wide, sixteen feet deep and twenty miles long.

Residents of Hyde Park and Lake have petitioned the Chicago council for a better water supply. They ask that the Hyde Park tunnel be extended two miles further into the lake, new pumping works be erected, etc.

The Keystone Water Company has been organized for the purpose of supplying Laflume, Pa., and Factoryville with water. Among those interested are James P. Dickson, Luther Kellar, David W. Brown, and Daniel Langstaff.

The Kalamazoo water mains will be extended on several streets at a cost of $8,000. The water-works committee has been authorized to advertise for 4 tons of 4-inch pipe, 25 tons of 6-inch pipe, 86 tons of 8-inch pipe, 43 tons of 10-inch pipe, 32 tons of 12-inch pipe, 11,000 tons of special castings, 21 water gates, and 12 fire hydrants.

Sewers.

Several sewers will be built at Bay City, Mich.

Springfield, Mo., will build a $100,000 sewer system.

Several sewers will be constructed soon at Toledo, O.

Extensive sewer work is being done at Fort Payne, Ala.

Sewers will be built to cost about $6,000, at Parsons, Kan.

Extensive sewer work will be done at once at Kankakee, Ill.

North Yakima, Wash., has voted $40,000 for a sewer system.

A new sewer district (No. 1) has been established at Findlay, O.

A complete sewer system is being agitated at Greenville, Texas.

A complete sewer system will be constructed at Grand Junction, Col.

The Waring system of sewerage will be adopted in Columbus, O.

Escanaba, Mich., will issue bonds for $20,000 for the construction of sewers.

The agitation for a complete sewer system at Knoxville, Tenn., is progressing.

Ordinances have passed the council of Columbus, Ohio, for numerous sewers.

Walla Walla, Wash., will vote July 8th, on issuing bonds for sewers and water-works.

Ordinances have passed the Kokomo council for the construction of several sewers.

At Wilkesbarre, Pa., the question of an insufficient sewerage system is being agitated.

South Bend, Ind., has passed resolutions for the construction of seven blocks of brick sewer.

About 13,500 feet of sewers will be laid this season at Butte, Mont. About $40,000 will be expended.

An ordinance has passed the Atlanta council for the construction of the Conally street sewer at a cost of $10,000.

Engineer A. R. Starke, of St. Paul, has commenced the survey of a complete sewer system at Cookston, Minn.

George E. Waring, Jr., of Newport, R. I., will superintend the construction of a $150,000 sewer at Middlesburg, Ky.

Sewer Commissioner Robert E. McMath, of St. Louis, has completed estimates for a $210,000 sewer in a new sewer district.

T. J. Pease of Nashville, has been awarded a contract for the construction of a complete sewerage system, at a cost of $24,884.26, at Clarksville, Tenn.

D. W. McConnell has been awarded the contract for building the remainder of the sewers in Tonawanda, N. Y., and work will be commenced at once.

The Grand Rapids, Mich., Board of Public Works has recommended the construction of sewers and water mains in State street, between Prospect and Waverly Place.

The Presideo Heights Improvement Club, of San Francisco, Cal., has taken measures to have a main sewer constructed through the Presideo reservation, at San Francisco.

Boston is to pay $62,000 to the town of Marlboro towards its proposed system of sewerage. This is an advance of some $20,000 from the first proposition made, and is owing to a change in location.

In the construction of the sewerage system for Athens, Ga., the outlet for one branch being unsatisfactory, the same will be extended at a cost of about $10,000, and work on said extension will be commenced in about sixty days.

Kirkland & Starkey have been awarded the contract for first alley sewer at Duluth, Minn., to cost $59,308.62. Forestall Bros. have a contract for Howard's Pocket sewer at $29,791.85. They have also the contract for the Nettleton avenue sewer at $28,570.10.

Public Parks.

Montezuma, Ga., will lay out a city park.

Tacoma, Washington, will establish a large park.

A park will be laid out at once at Rossville, Ill.

Greenville, Ala., has voted to establish a city park.

Extensive park improvements are being made at Lansing, Mich.

The West Nashville Dummy Co. will probably lay out a 15-acre park.

Bloomington, Ill., has appropriated $1,600 for improving the city's park.

The Davis estate at Fall River, Mass., will be purchased for a public park.

The People Street Railway Company, of Chillicothe, Ill, will lay out a park.

The Oclmulgee Land Improvement Company will donate a fine park to Macon, Ga.

The Winnebago Park Association at Fond du Lac, Wis., will make extensive improvements.

The Chautauqua Park Company, at Fort Worth, Tex., are making extensive improvements to their park.

Col. W. S. King has offered to give a 40-acre park to Minneapolis, Minn. The offer will probably be accepted.

Henry Joseph, E. Lasser, J. S. Downey, and others, will lay out a park to cost about $10,000, at Birmingham, Ala.

The Pasadena, Cal., Driving Park Association has been organized with a capital of $10,000, and will at once construct a driving park.

The governor of New York has signed the bill for the Martinville Park, which is to be called Braver Park, and the park commissioners may proceed with the work, when so directed by the Albany common council.

The New Orleans, La., Board of Trade has organized an Audubon Park Improvement Association, to improve the park of that name. F. J. Leach is president.

The Brookline, Mass., park commissioners will consider the question of taking for park purposes the lot of land lying between Longwood avenue and Francis street.

The Hartford, Conn., park commissioners have voted favorably on extending the remaining wall on the south bank of Park river at an expense not to exceed $5,000. The commissioners are also considering the advisability of making new sidewalks in South Park; also the improvement of Tunnel Park.

Street Lighting.

The Terre Haute Gas Light Company will extend its mains.

The streets of Iola, Kan., will probably be lighted with natural gas.

The Land and Improvement Company, at Fort Wayne, will extend its natural gas mains to Lakeside.

S. A. Hostetter and Geo. S. Schneiderman will probably organize a company to supply Ansonia, O., with gas.

The Terre Haute Gas Company has let the contract for building gas holders to the Stacy Manufacturing Company, Cincinnati.

The DuQuence Gas Company has been granted a street franchise, and pipe lines will be laid on sundry streets in Sharpsburg, Pa., at once.

The Pittsfield Gas Company has been awarded the contract for lighting the streets of Pittsfield N. H., and will commence to lay pipes at once.

Messrs. Donahue & Richardson, of the Finance Committee of the Nashville Board of Public Works, have been authorized to make inquiries about the advisability, cost, etc., of whole or part ownership of the gas plant by that city.

Wm. St. John, of the Pintch Gas Lighting Department, of the Safety Car-heating and Lighting department, in New York city, has let the contract for the construction of a $20,000 plant to manufacture their gas lighting apparatus and gas, at Atlanta, Ga.

SEALED PROPOSALS.

IMPROVED SEWERAGE SYSTEM.

Sealed proposals will be received at this office until 11 o'clock A. M., Thursday, June 26, 1890, for building Sections 1, 5, 6, 7, 8 and 9 of the Improved Sewerage System of the City of Providence in accordance with the form of contract and specification to be furnished by the commissioner.

All proposals must be made upon the blank forms which will be furnished for the purpose.

Plans may be seen and specification and form of contract can be obtained at the office of the city engineer in Providence.

Each bidder is requested to give references as to his business standing and to state generally what experience he has had in such work as here proposed.

A satisfactory bond for a sum equal to about one-tenth of the estimated amount of the contract, or a certified check for an equal amount, as liquidated damages for failure to execute the contract within ten days, if awarded, must accompany each proposal and a satisfactory bond for a sum equal to about one-third of the estimated amount of the contract, conditioned upon the faithful performance of the contract, will be required of the successful bidder.

The right to reject any or all proposals is reserved.

JOHN A. COLEMAN,
Commissioner of Public Works.

PUMPING MACHINERY.

The city of East Liverpool, O., will receive proposals for additional pumping engines on the 25th day of June, 1890, at 1 o'clock P. M., at the office of the Trustees, where they will be opened and publicly read.

At the same time and place, bids will be received for two 14-inch suction supply pipes, about 500 feet each, laid in the Ohio river, connecting to a 24-inch Y-pipe laid in the wall of the supply well.

Also, for the suction well, about 25 feet from the pump house.

Also, for a rising main, leading from the pump house to the present reservoir, about 850 feet long, 20 inches diameter. There will be a number of stop-valves, elbows, strainers and supports to put in place. Specifications sent on application. Separate bids will be received for supplying the material and performing the labor.

The board reserves the right to accept the bid which, in their judgment, is the best, also to reject any and all bids.

Specifications sent on application.

EAST LIVERPOOL WATER WORKS, East Liverpool, O.
N. A. FREDERICK,
J. H. HARRIS,
H. A. MCNICOL,
Trustees.

GRADING, IMPROVING AND MACADAMIZING COUNTY ROADS.

Sealed proposals will be received at the place of meeting of the Board of Chosen Freeholders, at the Court-House, in the City of Elizabeth, County of Union, and State of New Jersey, until the hour of three o'clock in the afternoon, on Thursday, the nineteenth day of June, 1890, as follows:

For grading where necessary and Macadamizing or Telford paving, for the width of sixteen (16) feet in the center thereof, of Westfield Avenue, in the City of Elizabeth, from the boundary line of the township of Union to the intersection of the said Westfield Avenue, with the westerly side of North Broad Street, in the City of Elizabeth, in said County of Union and State of New Jersey.

It is estimated that the following quantities of work and material will be required to be done and furnished on said road or avenue: Nine thousand two hundred and eleven (9,211) square or superficial yards of macadam or telford pavement.

Plans and specifications, and also the conditions only under which said proposals or bids shall be received, may be examined at the office of F. A. Dunham, County Engineer, No. 7 Park ave., Plainfield, N. J. Printed copies of the specifications and also of said conditions under which said proposals or bids shall be received can be had at the office of the aforesaid Engineer, and also at the office of E. M. Wood, County Collector, Elizabeth, N. J. All bids or proposals to be addressed to J. F. Hubbard, Director, Court House, Elizabeth, N. J.

The right to reject any or all bids for said work is reserved by said Board, as may be deemed for the best interests of the County, and notice is hereby given that the bids will be opened publicly at a meeting of the Board of Chosen Freeholders, to be held on said nineteenth day of June, at three o'clock in the afternoon, at their place of meeting, in the Court House, Elizabeth, N. J.

F. A. DUNHAM,
County Engineer.

STAND PIPE.

Proposals for a wrought iron or steel stand-pipe 100 feet high by 20 feet diameter are invited by the Board of Sanitary and Water-Works Commissioners of Waycross, Ga., until 12 o'clock M. of Thursday, June 12 next. Address all communications and bids to

H. MURPHY, Chairman, Waycross, Ga.

STREET IMPROVEMENT.

About five miles of the streets of the city of Westminster, Md., will be macadamized at once during summer and fall. Contractors having complete outfit preferred. Specifications forwarded upon application. Apply to F. K. NEW, Mayor, or C. H. BAUGHMAN, Clerk, Westminster, Md.

WATER-WORKS TUNNEL.

Sealed proposals will be received at this office until Friday, June 20, 1890, at 10:30 o'clock A. M., for furnishing all materials and doing all the work necessary and required to construct a water-works tunnel seven and one-half (7½) feet in diameter, out three thousand (3000) feet under Lake Michigan, including two (2) shafts, wells and crib, according to plans and specifications on file in this office.

Bidders will submit their bids in accordance with the terms of the specifications.

Work to be completed on or before the first day of June, 1891, failing in which the contractor shall pay to the city of Milwaukee, as liquidation damages, the sum of $700 per day for each and every day's delay in completing the contract.

Bond to accompany bids required in the penal sum of $40,000, signed by two sureties, or in lieu thereof the bidder may deposit with the Board of Public Works the sum of $20,000 in money or certified check, payable to the board. Sureties must be residents of this city.

All bids must be stated in writing and in figures.

All moneys deposited will be returned to unsuccessful bidders on award of contract, and to successful bidders when contract is entered into.

Before the award of contract the Board of Public Works must be satisfied of the ability and facilities of the successful bidders to perform the work according to the terms of the specifications and this advertisement.

The Board of Public Works reserves the right to reject any or all bids.

G. H. BENZENBERG,
G. DUNCK,
W. P. O'CONNOR,
G. P. TRAEUMER,
Commissioners of Public Works.

Countersigned,
FRED F. WILD,
Deputy Comptroller.

SEWERS.

Sealed proposals addressed to the Board of Public Works, care the City Engineer, will be received at the office of the City Engineer, in Nebraska City, Neb., until 10 o'clock A. M., June 20, 1890, for the furnishing of all the material, labor and building complete for a twelve inch, double thick, vitrified clay pipe sewer, from the city limits, near the packing houses, to the Missouri River.

SEWERS AND DRAINS.

Sealed proposals will be received by the Commissioners of Sewers and Drainage of the Village of New Rochelle, Westchester County, N. Y., until 6 o'clock P. M., June 14, 1890, for the construction of Sewers and Drains in and for said Village of New Rochelle, in accordance with plans and specifications on file with Horace Crosby, C. E., Main street, New Rochelle, N. Y., being known and designated as plans and specifications for Section No. 3 of Sewers and Drains for said Village.

Each proposal must be accompanied by a bond in the penal sum of five thousand dollars, with two sureties, conditioned that same shall be forfeited to the Commissioners if the person or persons to whom the contract may be awarded shall neglect or refuse to execute the same within ten days after being notified by the Secretary of the Commissioners that his or their proposal has been accepted.

The contractor will be required to furnish a bond in the penal sum of Twenty Thousand Dollars, with two or more sureties approved by the Commissioners, conditioned and as security for the faithful performance of the contract and as indemnity for damages, etc., as provided by Section 8, Chapter 201, Laws of 1889.

The Commissioners of Sewers and Drainage reserve the right to reject any or all preposals, and to award the contract to other than the lowest bidder, or to readvertise for proposals if they shall deem such course advantageous to the interests of the Village of New Rochelle.

Plans and Specifications can be seen, form of proposal and further information can be obtained at the office of Horace Crosby, C. E., Main street, New Rochelle, N. Y.

By order of the Commissioners.

H. T. VULTE, Secretary.

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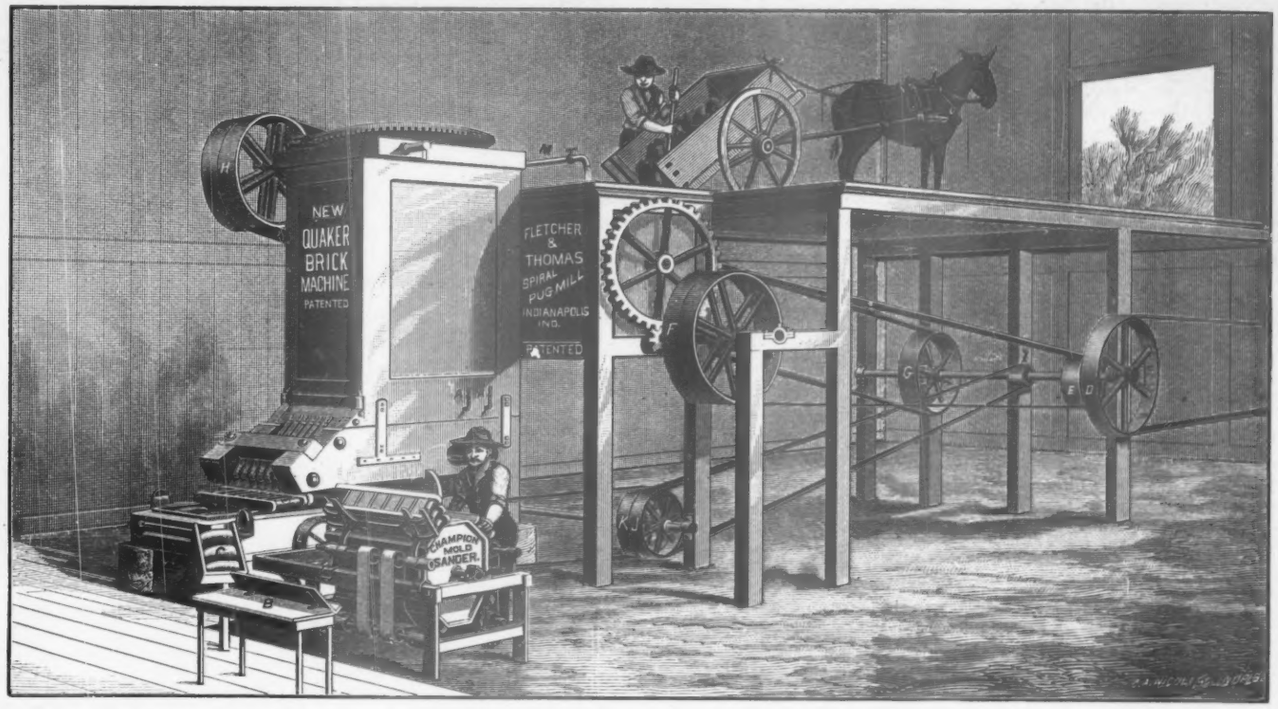

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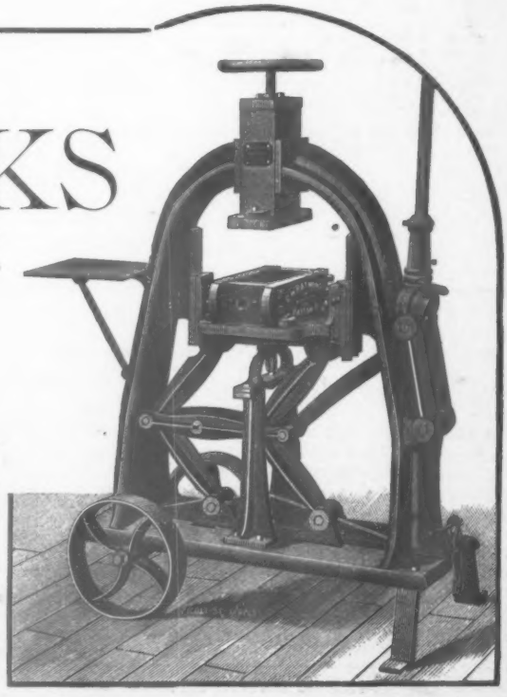

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